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ELECTRONICS AND ELECTRICAL ENGINEERING

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AMPLIFIERS

UDC 621.375.4

LINEAR PULSE AMPLIFIERS WITH DISTRIBUTED GAIN BUILT ON MOS-TRANSISTORS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 109-112
manuscript received 24 Feb 79

SKLYARENKO, A.I.

[Abstract] The URU-1 pulse amplifier is described which features a gain distribution over six stages, each built on a hybrid "MOS transistor-bipolar transistor" cascode and connected into a "common source-common drain" circuit. It is assembled on a 217x102 mm^2 large 2-mm thick bilaterally copper-clad Textolite board. It has been designed to operate in class B with small currents (15 mA) per stage and in class B with large currents (up to 120 mA) per stage for amplification of positive and negative pulses, respectively, with amplitudes up to 4 V, also in class A with quiescent currents of 40-50 mA. The overall gain is 13 dB at frequencies up to 200 MHz, with the nonlinearity of the amplitude-frequency characteristic not exceeding 3 dB within this frequency range. The output pulse has a risetime of 1.7 ns, a maximum amplitude of 16 V across a 75 ohm load, and an amplitude characteristic linear within 3 percent. A variant of this amplifier, the URU-2 output amplifier, has each of its six stages built on MOS transistors and connected into a 'common source-common gate' circuit. It was designed for operation with the deflection system in a 2TZS-8 high-speed CRO memory tube. With a URU-1 as a preamplifier, it can deflect the recording beam of this CRO as much as 22 mm. Its performance characteristics are not very different from those of the URU-1 amplifier. Figures 3; tables 1; references: 6 Russian.
[97-2415]

UDC 621.375.087.9

INCREASING THE SPEED OF K14UD1 OPERATIONAL AMPLIFIERS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 113-114
manuscript received 1 Mar 79

PETIN, G.P., RUDKOVSKIY, V.N., MAKIYENKO, A.V., KHRISTICH, S.V. and IVANTSOV, S.Ya., Rostov State University

[Abstract] The K140D1 operational amplifier is described. It has an additional output stage which does not, as conventional output stages do, reduce its speed.

The stage is based on a low-power high-frequency p-n-p transistor and is connected into a common-emitter circuit, with the base of the transistor connected to the output of the second differentiating stage so that the base current does not exceed 100 μA and in no way affects the amplifier performance. Applications for this operational amplifier include high-precision power supplies and wideband generators of voltages with rectangular or triangular waveform. Figures 4; references: 4 Russian. [97-2415]

UDC 621.375.122

AMPLIFIERS USING LOGIC INTEGRATED CIRCUITS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 89-91 manuscript received 26 Apr 78

BURYAK, V.A., ZAVADOVSKIY, A.Z., ZAYARNYY, P.P. and NEILO, N.I.

[Abstract] Some series-produced Soviet logic IC's can be used as amplifiers, having better size, weight and power consumption parameters than their analog counterparts. The design of such amplifiers is discussed in the light of requirements for identical instrumentation channel amplifiers: a minimum number of outboard components and amplifier specifications which are as nearly identical as possible. Four basic amplifier configurations using external resistors are shown schematically and the parameters of such amplifiers (e.g., the signal frequency, cutoff frequencies, output voltage, input and output impedances, gains and values of the external resistors) are shown in tabular form for the following IC series: 114, 113, 176, 178, 136, 134, 131, 137, 133 and 155. The advantages of the various circuits for specific instrumentation requirements are considered and a design example of a dual channel pulse and sine wave amplifier is given. A 1LB333 logic IC is used as the amplifying element, while the microcircuit is based on hybrid film technology using unpackaged 2T307B transistors and K10-9 capacitors. The overall amplifier, which is fabricated on a sitall substrate 15 x 16 mm and housed in a K-153-15-1 package has the following specifications: supply voltage of 5 ± 5 percent volts, a gain of 50 ± 20 percent for each channel; the channel gains are within 0.5 percent or less of each other, the input impedance is 5 Kohms, output impedance is less than 50 ohms, the upper cutoff frequency is 40 MHz while the peak pulse output voltage is 2.2 v; channel separation is better than 30 dB at 1 MHz. As compared to the dual channel amp using the 2US655 microcircuits, the new design provides a weight advantage of a factor of 4, a size improvement by a factor of 6 and a power consumption reduction by a factor of 2.5 times. Figures 4; tables 1; references: 3 Russian. [29-8225]

UDC 621.396.677.494

ON THE IMPACT OF NOISE ON THE CHARACTERISTICS OF THE SYNTHESIZED DIRECTIONAL PATTERN OF RECEIVING ANTENNA ARRAYS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 25-29 manuscript received 14 Jun 79

BOGACHEV, A.S.

[Abstract] A digital processing algorithm derived by the author in an earlier paper [RADIOTEKHNIKA, 1978, No 6] for the signals received by individual elements when synthesizing the directional pattern of receiving antenna arrays is extended to take into account the influence of noise on the pattern. The impact of the number of quantization levels of the signals and the weighting factors on the pattern characteristics is analyzed, considering the internal noise of the receiving elements and the receivers. It is assumed that the signal at the input of the IF amplifier of any channel can be represented as an additive mixture of the useful signal and interference. A general analytical expression is adduced for the covarication function of the composite signal, which takes the form of a complex discrete random process. The general expression is applied to pattern synthesis with small input signal-to-noise ratios, where binary quantization is used in the digital device generating the pattern. Sample calculations show that: the resolving power of the array considerably depends on the height of the noise pedestal, which is caused by the internal noise of the array elements and receivers as well as the quantization noise; in a number of cases, it can be practically zero. The normalized function describing the directional gain increases with an increase in the input signal-to-noise ratios in the case of a fixed number of array elements, although the rate of this rise falls off in step with the increasing number of elements. The height of the noise pedestal also falls off in step with the increase in the number of elements, although the rate of the drop decreases with an increasing number of elements. A very simple approximation formula is given for the maximum power signal-to-noise ratio at the output of the digital device shaping the directional pattern for the case of binary quantization where the input signal-to-noise ratios are less than 0.3. Figures 3; references 3: 2 Russian, 1 Western.
[29-8225]

UDC 621.396.677.494

THE POSITION AND SIZE OF THE MAXIMUM OF THE MAIN LOBE OF A FOCAL SPOT

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 70-72 manuscript received 24 Dec 79

LEVIN, A.S.

[Abstract] In moving from the geometric center of an antenna array to the phase center, a monotonic or nonmonotonic change in the field intensity is observed, depending on the parameters of the antenna and the coordinates of the focus. In the nonmonotonic case, there are extrema. The region of the focal spot bounded by minima of the field closest to the focus is called the main lobe of the focal spot. The paper derives analytical expression for the position and magnitude of the maxima of the main lobe of the focal spot of a phased antenna array consisting of identical radiators, the phase centers of which are arranged in a plane along the points of an ellipse. The errors in the derived equations are illustrated graphically. More complex second and third order approximations for the size and location of the main lobe maxima, as well as the corresponding errors are also given, and it is shown that the worse case errors are never more than about 1 percent. The formulas cover the majority of practical applications. Figures 4.
[29-8225]

CERTAIN ASPECTS OF COMPUTER HARD AND SOFT WARE: CONTROL, AUTOMATION, TELEMECHANICS, TELEMETERING, MACHINE DESIGNING AND PLANNING

UDC 681.3.001

ON ONE METHOD OF SYNTHESIZING MULTICHANNEL HIGH-SPEED PSEUDORANDOM NUMBER GENERATORS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY. PRIBOROSTROYENIYE in Russian
Vol 23, No 8, Aug 80 pp 45-47 manuscript received 17 Jul 79

YARMOLIK, V.N. and MOROZEVICH, A.N., Minsk Radio Engineering Institute, recommended by the Department of Electronic Computers

[Abstract] The effort to increase the operational speed or the range of pseudorandom number generators necessitates the use of a group of single channel generators in parallel, something which increases the equipment volume and cost. A method of synthesizing multichannel generators is proposed which is distinguished by reduced equipment costs. The basis for the proposed technique is a generator design previously developed by the authors [RADIOTEKHNIKA I ELEKTRONIKA, Minsk, 1977, No 7] which allows the synthesis of single channel, m-digit parallel generators. The basic steps in the synthesis are: 1) In order to determine the value of the number of channels, n, appropriate systems of equations are written which are then converted to systems of equations having only two terms on the right side; 2) For a specific value of the bit capacity of the shift register, m, a system of equations is constructed which generates the individual bits of the pseudorandom numbers in all channels; and 3) The basic of the multichannel generator is designed around the derived systems of equations. The technique is illustrated by the synthesis of a dual channel, five digit pseudorandom number generator. A block diagram of the resulting device is shown. Figures 1; references: 3 Russian.
[25-8225]

UDC 621.317

A SET OF INTERFACES FOR HOOKUP TO THE 15VSM-5 COMPUTER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 247-248
manuscript received 22 May 79

ALEKSANDROV, A.L., GULAYEV, I.B., ZHDAN, A.G., KLOCHKOVA, A.M. and LUSHNIKOV, N.A.

[Abstract] A set of interfaces is available for hookup of serially manufactured measuring instruments to the 15VSM-5 computer, to facilitate data collection and processing as well as control of physical experiments and graphical or numerical presentation of results. The set includes a master controller, a class 0.1

digital-to-analog converter, a 10^{-2}-$1.6.10^2$s time base generator, a command commutator, and interfaces for digital meters, for a recording instrument, for a EUM-23 digital printer, for PLU-1 and PL-80 tape punches, and for up to eight independently connected pieces of peripheral equipment. Information concerning this complex of interfaces may be obtained from the address: 103907, Moscow, GSP-3, Prospect Marks 18, Special Design Bureau of the Institute of Radio Engineering and Electronics, USSR Academy of Sciences. Figures 1.
[97-2415]

CIRCUIT THEORY AND PRACTICE

UDC 621.373.52(088.8)

A NONLINEAR MULTICHANNEL PEAKING LINE

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 132-135 manuscript received 11 Mar 79

SHVETS, V.A., Joint Institute of Nuclear Research, Dubna

[Abstract] A nonlinear multichannel peaking line with an input characteristic impedance of 1.5 ohm has been developed in order to produce nanosecond drops of kiloampere currents in the electron-beam monochromatization system of the LIU-30/250 electron accelerator. It consists of identical capacitor cells, all plates of one polarity connected by wires parallel to the axis so as to form the split outer conductor. The geometry of the latter conductor is designed for specific values of L_0 and C_0, and thus also of the characteristic impedance ρ_0, with ferrite rings inside dielectric cups slipped over the wires between neighboring capacitor plates. The parameters of this line were measured with a linear pulse generator including a thyratron, two oscillographs (S1-11 and Tectronix 7904), a set of pulse-voltage dividers with connectors and loads, and a d.c. demagnetizer. The decrease of the risetime and of the delay time of a surge current wave with increasing wave amplitude and with increasing demagnetization current indicates a performance similar to that of conventional coaxial peaking lines, but the much lower characteristic impedance is an attractive feature for a wider range of applications in high-current systems. Figures 4; references: 7 Russian.
[97-2415]

UDC 621.373.521.11

THE LOAD AND NOISE CHARACTERISTICS OF AN AVALANCHE TRANSIT-TIME DIODE AUTODYNE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 56-58 manuscript revised 27 Mar 80

KUZNETSOV, O.V. and STRUKOV, I.A.

[Abstract] The autodyne and noise characteristics of an avalanche transit-time diode oscillator running in a self-excited mode and driving a mismatched load are studied for two cases: 1) A maximum output power; 2) Maximum power efficiency. It is assumed that the low-frequency noise of the diode exceeds the microwave noise which is down

converted. An analytical expression is adduced for the power efficiency and the theory is tested using a 2A706 avalanche transit-time diode. The AM, FM and low frequency noise of the diode oscillator as well as the power efficiency and the change in the DC voltage across the diode are measured. An equivalent circuit is shown and the measurements are rendered graphically. Measurements of the AM, FM and LF noise as a function of frequency at the minimum and maximum power efficiency points indicate that the physical processes in the diode are independent of the degree of mismatching of the transmit channel. It is also noted that the experiment demonstrates the adequacy of the equivalent circuit and that changing the phase of the reactive inhomogeneity in the circuit permits a significant boost in the power efficiency of the autodyne, and can even compensate for the undesirable impact of the external load. Figures 3; references: 5 Russian.
[29-8225]

UDC 621.374.2

HIGH-SENSITIVITY SIGNAL SHAPERS FOR PHOTOELECTRON MULTIPLIERS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 137-141
manuscript received 12 Feb 79

BALDIN, B.Yu., Institute of High-Energy Physics, Serpukhov

[Abstract] Three signal shapers for a 2-arm focusing spectrometer are described which do not include discrete threshold elements, and thus feature a high repeatability and stability of parameters. One of them, the 6UD-19 with a tracking threshold, is to be mounted near the photoelectron multiplier and produces a signal independent of the amplitude of the time marker over the 5-500 mV dynamic range of input signals. It consists of wideband differential 2-transmitter amplifier on two differential receiver stages, as well as a threshold discriminator on an RS-trigger and a time marker integrated on a single microcircuit chip. The two others, NPF-11 and NPF-12, have respectively a fixed and an adjustable threshold. Both consist essentially of a 2-stage amplifier on a differential receiver, with feedback resistors which stabilize the gain and set the operating point of the second stage to logic 1. While the NPF-11 is designed for processing signals from Cerenkov and scintillation counters, the NPF-12 is designed for experiments in accelerators and to be built into the housing of the photoelectron multiplier so as to allow for a lower operating voltage with a corresponding attenuation of the loading effects. Here the signal shaping univibrator output stage can operate with holding throughout the pulse duration or with dead time. The author thanks Z.V. KRUMSHTEYN, V.I. KRYSHKIN and A.I. RONZHIN for helpful discussions, and also A.S. DYSHKANT AND G.I. LANSHCHIKOV for assistance in making measurements. Figures 5; tables 1; references: 6 Russian.
[97-2415]

COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS AND TRANSMITTERS, NETWORKS, RADIO PHYSICS, DATA TRANSMISSION AND PROCESSING, INFORMATION THEORY

UDC 621.372.51

A THERMALLY STABLE WIDEBAND BIPOLAR SIGNAL CONVERTER

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 46-47 manuscript received 24 Dec 79

DOLZHENKOV, V.A., KOBZEV, V.V., KOZHEMYAKIN, N.G., and KOMLYAKOV, V.V.

[Abstract] General purpose devices for matching instrumentation to radio equipment must have a wide dynamic range for the bipolar input signal, a high input impedance, a wide bandwidth and good temperature stability. This paper describes a converter which normalizes the input signal amplitude and converts the bipolar signal to a single polarity signal. The unit is designed around a 2P301B FET input transistor, two T326A and T312B bipolar transistors, a KS147A zener diode, two 522SA1 and two 133LB3 integrated circuits. A schematic of the converter is shown and the operation of the circuit is discussed. The specifications are: dynamic range at the input of ±0.1 - ± 5 volts; input impedance of 0.5 Mohms; bandwidth of 40 MHz in providing for the zero level transmission; temperaturestability of 0.4 mv/°C; power consumption of 750 mW; load impedance of no more than 2 Kohms and an overall gain of 0.7 to 0.8. The device is packaged as a miniature portable circuit tester. Figures 2; references: 3 Russian.
[29-8225]

UDC 621.378.9:621.396.963.965.8

ON THE GUIDANCE PRECISION IN OPTICAL COMMUNICATIONS LINKS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 23, No 8, Aug 80 pp 80-83 manuscript received 3 May 79

MINAYEV, I.V., Moscow

[Abstract] The design of optical communications links involves a trade-off among a number of factors; a high signal-to-noise ratio, data transmission rate, precision in the determination of moving object parameters, and others, and the concomitant high tracking precision versus the necessity of working with the maximum permissible guidance error in order to facilitate the dynamic operation of the tracking system. This paper studies the relationship between the angular guidance precision in laser communications systems and the information capacity of a

communications channel as well as the optical antenna quality. A factor is introduced as a measure of actual system quality which is related to ideal system performance and subsequently used in a simple analytical expression for the maximum permissible tracking error. It is shown that the permissible error is approximately one-sixth the width of the directional pattern of the optical antenna. Figures 2; references 3: 1 Russian; 2 Western (1 in translation)
[25-8225]

UDC 621.391.23.03.73

AN EXPERIMENTAL STUDY OF THE ERROR IN REPRESENTING SOME SIGNALS BY A FOURIER SERIES

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 68-69 manuscript received a 3 Dec 79

SEDYAKIN, V.P. and PECHENKIN, A.S.

[Abstract] In an experimental study of the error in the representation of two different types of signals by a finite Fourier series, two digital information flows were generated based on an analog signal from an analog-to-digital converter. The first flow differed from the second by the amount of the digitization frequency, which exceeded the second by an order of magnitude or more. The digitization rate for the first flow was 2,000 Hz; that of the second interrogation frequency was varied by a factor of 1 to 6 times the signal cutoff frequency. Amplitude quantization errors were excluded, because the digit representations comprising the second data flow were regularly sampled digit readouts from the first flow. The normalized correlation functions of the signals are shown along with the spectral densities and errors in the reproduction of these signals using finite Fourier series for a digitization frequency of 93 Hz for the second flow. The discrete representation of the signal uses Fourier series from the standard Fourier-157 program for the BESM-6 computer. The error criterion is the mean square deviation of the stored signal from the actual signal itself. The error is a maximum of 5 percent for a digitization frequency of 180 Hz and a minimum of 3.15 percent at 480 Hz for the information flow from the first generator. With high enough values of the digitization frequency, it is possible to reduce the error, because the spectral density in this case at the low signal frequencies is also small and about equal to its high-frequency value, where there is as yet no signal; then the use of a digital filter in a digital computer during signal recovery can cut off the high-frequency component errors above the signal cutoff frequency, so that the mean square error in the restoration can be even less than that obtained experimentally here. It is noted that the application of the results is not limited to signal representation, but can also be applied to data processing on digital computers. Figures 4; references: 4 Russian.
[29-8225]

COHERENT-OPTICAL SPECTRUM ANALYSIS AND CORRELATION PROCESSING OF SIGNALS RECORDED BY MEANS OF COMBINED MODULATION

Moscow TEKHNICHESKAYA KIBERNETIKA in Russian No 6, Nov-Dec 80 pp 156-166 manuscript received 23 Jan 80

YEZHOV, V.A. and TARASOV, L.V., Moscow

[Abstract] Circuits are considered for coherent-optical spectrum analysis and correlation processing of one-dimensional signals recorded by means of combined modulation of the transmission of a transparency (space light modulator). An amplitude variation of a combined modulation (combination of halftone modulation with modulation of the line aperture) is used with the spectrum analyzers. A phase variation--a combined halftone modulation with circuit representation of the signal--is also used with the correlators considered, together with the amplitude variation mentioned. The following items are studed: 1) In connection with spectrum analysis, single- and multiple-channel spectrum analyzers and a spectrum analyzer with a two-dimensional Fourier transform of raster combined recording. (The analysis is conducted for the case of a simultaneous half-tone and silhouette modulation of the transmission with the presence of two-one-dimensional real signals subjected to combined spectral analysis.); and 2) In connection with correlation processing, single- and multiple-channel correlators based on amplitude combined modulation, and a correlator based on phase combined recording. It is concluded that the principal merit of the circuits analyzed, which in principle distinguishes them from the traditional, is the unique input transparency for leading in together of the processable signals. This makes it possible to employ an optically controlled transparency (for example, liquid crystal in combination with an electron-beam tube) as a device for lead in of electrical (radio) signals. The input device in question easily makes it possible to realize amplitude and phase variations of the combined recording of the original signals. The schemes considered are very promising for realization of coherent-optical systems for multichannel data processing, operating in real time. The authors thank V.A. L'YAKOV and I.N. KOMPONETZ for much attention to the work and helpful council. Figures 8; references 12: 4 Russian, 8 Western.
[106-6415]

UDC 621.396.2

THE OPTIMAL DISTRIBUTION OF THE POWER RESERVE IN A FREQUENCY DIVERSITY COMMUNICATIONS SYSTEM

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 30-32 manuscript received 10 Dec 79

POSTYUSHKOV, V.P.

[Abstract] The noise immunity of transmission systems using frequency spacing of the signals depends not only on the type of modulation and signal processing, but also on how the transmitter power is distributed among the individual transmission subchannels at the different frequencies. The problem of optimum power distribution

among the diversity subchannels is solved for the case of a system where the fading in the channels is independent and has a Nakagami distribution over the channels; the channels are assumed to be statistically inhomogeneous. An expression is adduced for the error probability in the case of optimal incoherent reception of binary signals with an active pause and coherent combining of the signals from the various diversity channels. The minimization of this error function generates the requisite optimal distribution ahd the specific analytical expressions are applied to the example of the distribution for an eight channel system. It is shown that the analytical function yields a unique solution and guarantees precision of the final optimal power distribution. Figures 2; references: 2 Russian.
[29-8225]

UDC 621.396.6

ON THE SYNTHESIS OF RECEIVERS WHICH ARE OPTIMAL IN THE SENSE OF A D-CRITERION

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 38-39 manuscript received 14 Dec 79

KHVOROSTENKO, N.P.

[Abstract] D-optimal receivers provide for a minimum distortion probability in the reception of discrete information. The D-criterion specifies that a packet of erroneous and correctly received symbols, starting and ending with the erroneously symbols, in which the number of symbols received correctly in a row does not exceed r-1, is termed r-th order distortion. Thus, D-optimal receivers minimize the erroneous reception probability of a binary symbol, given the condition that the r preceding symbols are received correctly. The synthesis of such receivers is based on a study of a likelihood function written in terms of probability density of the received signal, the complex vector of the low frequency equivalent of the received signal, the possible value of the received information symbol and a vector of r decisions concerning the preceding value of the information symbols. The general mathematical treatment generates expressions which indicate criteria for maximizing the signal-to-noise ratio, even in the case of pulse interference. No specific circuits or sample calculations are given. References: 2 Russian.
[29-8225]

UDC 519.213:621.372.54.01:621.391.82

THE APPROXIMATION OF THE PROBABILITY DENSITY AT THE OUTPUT OF POSTDETECTOR COMB FILTERS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 65-67 manuscript received 17 Oct 79

FEL'DMAN, Yu. I.

[Abstract] In the general case of the determination of the probability distribution at the output of a discrete filter (either a storage or rejection filter) which follows a square-law detector, a rigorous solution of the problem is difficult because it requires finding the roots of the characteristic n-th order equation (n is the number of readouts being summed) and is quite cumbersome when the number of roots is large. The approximation of the precise distribution with a gamma distribution as a function of two parameters has been shown to be unacceptable in many cases. Moreover, the gamma distribution cannot be used to describe a bipolar voltage distribution, i.e., the voltage at the output of a suppression filter. This paper develops a technique for approximating the distribution which is quite accurate and suitable for storage and rejection filters. The essence of the procedure consists in the fact that the entire set of n roots of the characteristic equations of the system is replaced by two roots with multiplicity factors chosen so that the first four cumulants of the approximating and approximated distributions match up. They are then used to construct an approximate distribution which depends on the four parameters. The proposed technique is applied to the example of a recirculator with delayed feedback, inserted after a square-law detector, with white noise fed to the detector input. The recirculator is either a storage or a suppression filter, depending respectively on whether the feedback is positive or negative. The precise differential distributions calculated on a computer are compared graphically with the results of the gamma distribution approximation, as well as the proposed technique. The curves show the unacceptability of the gamma distribution and the good agreement of the proposed method with the precise values. If greater approximation accuracy is needed in any case, the method can be modified appropriately, though this complicates the calculations. In the majority of cases this is not justified. Figures 2; references 10: 7 Russian, 3 Western.
[29-8225]

UDC 621.314

A PULSE TRANSFORMER WITHOUT A FERROMAGNETIC CORE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 20-24 manuscript received 19 Feb 80

VDOVIN, S.S.

[Abstract] A second order integro-differential equation is written for the transient response of the equivalent circuit of an air-core pulse transformer. The equation is solved numerically on a digital computer to determine those design parameters which have the greatest impact on the distortion of the leading and trailing edges of the applied square wave, as well as on peak distortions. The derived analytical expressions are applied to the specific example of a pulse transformer used to boost the amplitude of a 2 microsecond pulse produced by a generator designed around a 2T917A transistor with a collector supply voltage of 100 volts and a current of 10 amps in order to obtain the maximum power with a secondary voltage of 100 volts. The increase in the rise time and the voltage overshoot at the leading edge were to be less than 0.2 microseconds and 2 percent respectively. The resulting air-core design is configured as two concentric coils on a common cylindrical form, with the primary wound on top of the secondary and separated from it by a thin layer of insulation. While the simplicity and ease of fabrication make the design promising for a variety of pulse applications, differences are noted between the calculated and measured values of winding inductance and capacitance, which are caused by unavoidable buckling of the insulation during the construction of the coil, the inaccuracy of the original formulas and measurement errors, though all fall within a permissible range for practical calculations. Figures 4; tables 3; references: 3 Russian.
[29-8225]

UDC 621.372.44:621.316.824

COMPONENTS HAVING AN ELECTRICALLY CONTROLLABLE RESISTANCE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 82-88 manuscript received 27 Mar 79

KRYLOV, G.M. and KHONYAK, Ye.I.

[Abstract] The entire class of two terminal devices, the resistance of which varies as a function of the applied electrical control current, voltage or electromagnetic field, is surveyed. The various categories of controlled resistance devices are defined and the features of the following devices are discussed in more detail: diodes, including pin-diodes; bipolar transistors, FET's, varistors, thermistors, photoresistors and phototransistors, magnetically controlled resistors and diodes, Hall-effect transducers as well as composite type controlled resistors built up from a switch and an operational amplifier. This general review summarizes the parameters of these devices (the maximum variation in the resistance, minimum and

maximum values of the resistance, noise voltage, maximum frequency, control power, amount of decoupling between the control and signal circuits, the service life, size and a rating of the prospects for device use in microelectronics) in tabular form. It is concluded that variable resistors based on diodes, unipolar and bipolar transistors, optronic pairs and resistive transducers are the most promising for microelectronics. Figures 6; references: 18 Russian, 1 translated from Polish.
[29-8225]

UDC 621.372.54.037.372:519.724

QUANTIZATION ERRORS IN THE COEFFICIENTS OF A FILTER FOR A DISCRETE FOURIER TRANSFORM

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 36-38 manuscript received 17 Sep 79

SHCHELKUNOV, N.N.

[Abstract] A recurrent, discrete Fourier transform algorithm for a tunable recursive digital filter is analyzed in order to determine the influence of the quantization of the filter coefficients on its performance. The recurrent algorithm requires a comb of N filters, while the filter feedback loop has N registers to store the sequence of filter readouts; the feedback forms a "queue" type memory, the complete renewal cycle of which is equal to the arrival period of the input pulses. A merit of the device is its simplicity in as much as only one computer is used in the memory, although the processor must be rather fast, because for example, with a 32-point filter in a passband of 120 KHz, the time for the execution of the algorithm consisting of one complex multiplication and two complex additions should be less than 260 nanoseconds. An analytical expression is derived for the mean square value of an indicator of the deviation of a real filter from the ideal case and criteria governing the choice of filter parameters are discussed. A simple expression is given for the requisite number of filter digits as a logarithmic function of the measure of the deviation of the actual filter from the ideal. Figures 3; references: 3 Russian.
[29-8225]

UDC 621.372.852.6

MAXIMUM BANDWIDTH TRANSFORMERS (DC ISOLATING)

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 17-20 manuscript received 7 Sep 79

LONDON, S.Ye. and TOMASHEVICH. S.V.

[Abstract] Optimal bandwidth RF transformers, suitable for printed circuit applications, are formed from sections of uniform multiconductor lines. The length of the conductors and their configuration (concentric circles) are chosen so as to obtain the appropriate shunting inductance and the corresponding lower cutoff frequency.

This paper analyzes such DC isolating transformers, both unbalanced and balun types, for transformation rations of 1:n, where n can be any integer or fraction. The designs of a variety of baluns are shown along with analytical expressions for the phase-frequency response. The design considerations are illustrated by the single example of a balun to match a push-pull transistor amplifier with a 6 ohm load on each transistor to a standard unbalanced 50 ohm line. The power is 100 watts in a frequency range of 3 to 30 MHz. The resulting design uses two parallel sets of 12 rings each with a two layer stripline in one set and a three layer stripline in the other; all other parameters of the transformer are also given. Figures 7; references 5: 3 Russian, 2 Western.
[29-8225]

UDC 621.391.266

THE LOWER SAMPLING CUTOFF FREQUENCY IN THE CASE OF CONTINUOUS-DISCRETE FILTRATION

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 62-65 manuscript received 12 Mar 80

BAKAYEV, Yu.N.

[Abstract] A message put through an analog transmitter arrives via a noisy communications channel at the input to a time digitizer, which in turn feeds a receive processor which derives the message estimate. This configuration is analyzed in order to synthesize the optimal receive processor and to specify the signal parameters for which maximum precision is achieved. It is assumed that the messages have an asymptotically rectangular spectrum (Butterworth spectra). The continuous-discrete filtering analysis of the multidimensional message with a fractionally rational spectrum leads to expressions for the minimum sampling frequency at which the filtering error does not exceed a specified level. For the Butterworth messages treated in the paper, the most interesting feature is that as the number of sections of the shaping filter approaches infinity, the spectrum of such messages becomes rectangular. The minimum digitization frequency is then governed by Kotel'nikov's theorem. Errorless digitization is impossible for messages with an unlimited spectrum, though the error can be reduced to a specified level by increasing the quantization frequency. Specific calculations are given for filters of one to five sections; analytical expressions are derived for the digitization error in each of these five cases in the form of truncated power series. Figures 2; tables 1; references 5: 3 Russian, 2 Western.
[29-8225]

UDC 621.314.022:621.313.62-83

PERMISSIBLE LOAD OF A THYRISTOR CONVERTER WITH A SHUNTING RECTIFIER

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 10, Oct 80 pp 1095-1099 manuscript received 19 Dec 78, after completion 18 Feb 80

POPOV, Yu.V.

[Abstract] Electric d.c. drives are often energized through thyristor converters, with a shunting rectifier in the case of full control, and with or without a shunting rectifier in the case of partial control. As the control angle changes, a redistribution occurs of the load current between thyristor and rectifier, which depends largely on the ripple of the motor armature current and which in turn determines the maximum permissible thyristor load current. Here this problem is analyzed on the basis of fundamental voltage-current-time relations during the various distinct periods of a cycle. The number of phases as well as the conduction angle of the thyristor and the inductance of the motor armature circuit are taken into consideration, but the voltage drop across the resistance of the motor armature circuit is assumed to be negligible. Expressions for both instantaneous and average voltages and currents are tabulated, separately for the case of continuous current flow and the case of intermittent current flow. The results of subsequent calculations, all on a per-unit basis, are presented graphically in the form of curves of permissible armature current versus armature voltage, of particular interest being a 1-phase system ($m=2$) and a 3-phase system ($m=3$). These universal performance characteristics can be extended to other variants of thyristor-rectifier systems, for instance one where the shunting branch consists of two rectifier diodes in series. Figures 3; tables 2; references 3: 2 Russian, 1 German.
[99-2415]

UDC 621.8.02.087.92

A NEW TYPE OF VOLTAGE-TO-TIME-INTERVAL CONVERTER WITH INTERFERENCE IMMUNITY

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 80 pp 23-25

YAKOMASKIN, V.B., engineer, and SYTNIK, M.G., engineer

[Abstract] A new voltage-to-time-interval converter has been developed which, unlike conventional integrating converters, performs two conversions rather than only one during a period of the interference signal. The converter does not require either a special autotuner or a stable clock generator. It consists of

a push-pull modulator which receives the useful voltage signal together with the 50 Hz line interference signal, a shaper of clock pulses which is supplied from the line through a transformer and which switches the modulator at the interference frequency, an amplifier of modulated signals, and an integrator (operational amplifier) preceded by a capacitor, and in addition a time-delay generator, a reference-voltage generator, and a feedback-pulse shaper connected to the second integrator input through two amplifier-shaper transistor switches and to the integrator output through an amplifier-limiter. This feedback-pulse shaper, containing an inverter, two adders, two triggers, and another adder, puts out rectangular periodic voltage pulses which represent a time interval and whose duration does not depend on the interference voltage. The principle of conversion from a continuous sinusoidal voltage to this rectangular periodic pulse voltage is demonstrated here by solving the appropriate equations for voltages and currents as functions of time. The device, built with transistors and discrete microcircuits, can perform conversions at the rate of 100/s with a 50 Hz interference level below -40 dB and a nonlinearity error within 0.05 percent. It is already a part of the S ch4311 digital combination device produced at the "Elektroizmeritel'" plant in Zhitomir. Figures 3; references: 1 Russian.
[102-2415]

UDC 621.314.25:621.3.037.3

A PHASE-TO-CODE CONVERTER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 p 249 manuscript received 3 May 79

MORDOVA, V.I., SIVERTSEV, V.F. and SHTAREV, N.N.

[Abstract] A device was developed for conversion of the phase shifts of continuous and pulse radio signals into a parallel binary code. Inclusion of amplifier-limiter stages and shaping circuits for the quadrature components ensures an adequate dynamic range as well as an adequate frequency range. Interpolative processing of the quadrature components ensures accuracy and speed. External synchronization is provided by means of a pulse with a risetime not exceeding 20 ns. The converter can process radio-frequency pulses of 0.01÷1V amplitude and minimum 0.2μs duration with a duty cycle of 25-45 MHz and a maximum 20 dB amplitude unbalance. It measures phase shifts of 0-360°, the rms error of conversion not exceeding 3.5°. The readout is in an 8-digit parallel binary code, indicated with lights and fed to a computer. Information concerning this phase-to-code converter may be obtained from the address: 634050, Tomsk-50, Prospect Lenin 40, Tomsk Institute of Automated Control Systems and Radio Engineering, Department (Kafedra) of Information-Measuring Techniques. Figures 1.
[97-2415]

UDC 621.372.632

AN EXPERIMENTAL STUDY OF FREQUENCY MULTIPLIERS USING ELECTRON TRANSFER DIODES

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 58-60 manuscript received 2 Oct 79

ROMAN, O.A. and TREPAKOV, V.K.

[Abstract] The electron transfer diode takes the form of a single GaAs n-type chip, with a substantially nonlinear volt-ampere characteristic, in which a negative differential conductivity appears when the electrical field intensity exceeds a threshold level. Although previous Soviet literature has treated the possibility of using such diodes as frequency multipliers, where the microwave power fed to the multiplier is much less than that derived from the self-excited oscillator using the same diode, i.e., a power of tens of milliwatts, this paper deals with the case where the input microwave power is comparable to the power dissipated by the diode, i.e., a power of a few watts. Frequency triplers with output frequencies on the order of 10 and 30 GHZ using series produced AA703 and AA705 diodes are studied. Both multipliers yielded approximately the same results with input frequencies of 3.2 and 9.4 GHz. The conversion factors were 15 to 20 percent for an input power of 1 watt. The output power of the AA705 tripler at output frequency of 28.2 GHZ was 180 mw; the same diode as an oscillator delivered a power of 50 mw at 7.5 GHz. The admittance of the diode chip was measured as a function of the average electrical field intensity and the experimental curves for the capacity as a function of this field intensity confirm the theoretical conclusions of H.D. Rees [IBM JOURNAL OF RESEARCH AND DEVELOPMENT, 1969, Vol 13, No 9] concerning the nonlinearity of dielectrically constant GaAs. A schematic drawing of the experimental set-up is given along with graphs illustrating the performance. Figures 4; references 3: 2 Russian, 1 Western.
[29-8225]

UDC 681.335

COUPLING OF AN ANALOG-TO-DIGITAL CONVERTER TO A K580IK80 MICROPROCESSOR

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 10, Oct 80 pp 22, 27

GERASIMOV, I.V., candidate of technical sciences, and RODIONOV, S.V., engineer

[Abstract] A scheme is shown for coupling an analog-to-digital converter with double integration, first of the signal voltage and then of the reference voltage, as a peripheral device to a K580IK80 microprocessor operating in the "queuing loop" mode. The interface includes a time sharing unit, a synchronizing unit with a digital instrument for measuring time intervals, a comparator with an operational amplifier, a data busbar and an address busbar. The program of operation includes checking for readiness, after completion of a conversion cycle, as well as a subprogram of table lookup and of digital-equivalent data input. The microprocessor can also operate in the internal mode with a direct-access memory and a read-only memory only, or in the "cut in" mode in a system with a high throughput capacity, or with the peripheral equipment directly. Figures 1; tables 1.
[96-2415]

CRYOGENICS AND SUPERCONDUCTIVITY

UDC 621.373.52

AN OSCILLATOR FOR CALIBRATION OF SUPERCONDUCTING SOLENOIDS BY THE METHOD OF NUCLEAR MAGNETIC RESONANCE

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 157-159
manuscript received 16 Jan 79

VORONOV, O.A. and FILIPPOV, V.G., Institute of High-Pressure Physics, USSR Academy of Sciences

[Abstract] A simple and easily tunable Pound-Knight autodyne oscillator has been built on two field-effect transistors for calibration of magnetic fields produced by superconducting solenoids within the 5÷100 MHz frequency range. These KP306V 2-gate transistors have matched transfer characteristics and cutoff voltages, with a necessarily forward bias on the first gate. Metal powder molded in wax or single crystals of compounds can be used as transmitters of nuclear magnetic resonance, for measurement of magnetic field intensities ranging from 1 to 80 kOe. Fine-disperse aluminum (containing the $^{27}\mathrm{Al}$ isotope) and copper (natural copper containing both the Cu-63 and the Cu-65 isotopes) powder as well as single crystals of pink ruby (containing the $^{27}\mathrm{Al}$ isotope), of table salt (containing the $^{23}\mathrm{Na}$ isotope) doped with 0.1 atom. percent manganese, and of fluorite (containing the $^{19}\mathrm{F}$ isotope) doped with gadolinum have been found to be particularly suitable for this purpose. The resonance line of all these transmitters is 10-15 Oe wide. The authors thank S.V. KASATOCHKIN for the helpful consultations and N.N. LEVCHENKO for assistance in setting up the equipment. Figures 2; references: 5 Western.
[97-2415]

ELECTRICAL ENGINEERING EQUIPMENT AND MACHINERY: APPLICATIONS AND THEORY

UDC 621.313.1-133.32

A SPARK-PROOF ELECTRIC STEP MOTOR

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 80 pp 33-34

KATSMAN, V.M., candidate of technical sciences, DUKINA, L.A., engineer, and SOBOLEV, S.D., engineer

[Abstract] A spark-proof low-power electric step motor has been developed and tested at the Laboratory of Radioelectronic Devices of the All-Union Scientific-Research Institute of Mining Geomechanics and Mine Surveying in Leningrad. It is a 3°-step gear motor with a bidirectional solid-state commutator and a toroidal 3-phase winding. The motor is used in a railroad track profilograph as a reversible drive for the recording drum. Safety from sparking is ensured by means of shunting KD202 diodes across the coils mounted on the stator lugs. The commutator is built with series 176 microcircuits, and power amplifiers based on KT315 transistors. The motor weights 0.9 kg, is 125 mm in diameter and 45 mm long. It requires a 5 V storage batterv as the supply source. It meets the OAA.684.053-67 Standard for explosion-proof and mining equipment. Figures 1; tables 1; references: 3 Russian. [102-2415]

UDC 621.316.98.001.76

A METHOD OF IMPROVING THE PROTECTIVE CHARACTERISTICS OF LIGHTNING RODS

Minsk IZV. VUZ: ENERGETIKA in Russian No 10, Oct 80 pp 25-30 manuscript received 6 Aug 79

ALEKSANDROV, G.N., doctor of technical sciences, professor, IVANOV, V.L., candidate of technical sciences, docent, KADZOV, G.D., engineer, and KURILOV, V.A., candidate of technical sciences, Leningrad Order of Lenin Polytechnic Institute imeni M.I. Kalinin, presented by the Department of Electrical Equipment

[Abstract] A method of improving the protective action of a lightning rod, by means of placing near its tip a concentrated charge of a polarity opposite to that of the developing lightning discharge, is proposed in USSR Patent Disclosure No 456,383. This method was tried experimentally at the High-Voltage Laboratory of the Leningrad Polytechnic Institute with the aid of two 2250 kV-4950 kVA transformer banks which served as sources of high voltage, each capable of delivering positive or negative voltage pulses with amplitudes up to 2700 kV and a risetime of 3500 μs. Positive

voltage pulses were produced with one of them, their amplitude corresponding to a 95 percent probability of breakdown of an 8.2 to 15 m long discharge gap. The object of protection was a metal rod 0.05m in diameter and from 2 to 4.5 m high, mounted vertically on the ground. The lightning rod was a metal rod 0.05 m in diameter and 1.4 m high mounted 3.5-4 m away from the object on top of two 2.2m high insulator bases. As the high-voltage discharge electrode served a metal rod 0.05 m in diameter and 2 m high, mounted either directly above the object or halfway between the object and the lightning rod. Pulses of opposite polarities were applied to the discharge electrode and the lightning rod respectively. In one experiment on top of the lightning rod was further placed a metal spherical cap 0.4 m in diameter. The results of these experiments have confirmed the effectiveness of potential lightning rods, and especially of those with a large capacitance. They need not be higher than the protected object. These conclusions are supported by theoretical estimates on the basis of a model configuration. Figures 4; tables 1; references: 3 Russian.
[101-2415]

UDC 621.317.328

A NEW METHOD OF MAPPING HIGH-VOLTAGE ELECTRIC PULSE FIELDS

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 10, Oct 80 pp 1036-1038 manuscript received 9 Nov 78

KRAMERENKO, P.F.

[Abstract] High-voltage electric pulse fields can be mapped on glass plates with a layer of fine-disperse carbon powder. Accordingly, a Petri dish 15 cm in diameter and 1.3 cm high carrying a thin layer of carbon powder was placed on the lower disk electrode of a variable-gap capacitor and covered with an 18x20 cm^2 large clean glass plate directly under the upper capacitor electrode. The capacitor was charged from a 6 V battery through an induction coil. The electric field was mapped on the glass plate, the pattern depending on the interelectrode distance and the latter in turn determined by the diameters of the electrodes. The pattern also depended on the number of upper electrodes in the stack and on their shape. Electrodes with diameters of 4, 5, 6, 9.4, and 13 ^{M}m were used in the experiment. The interelectrode distance was varied over appropriate ranges such as from 10 to 45 mm for the smallest electrodes and from 43 to 64 mm for the largest electrodes. Bifurcation of the field pattern was found to occur at some sufficiently large interelectrode distance. The experiments were performed under standard conditions: pressure 956 hPa, air temperature 291 K and relative humidity 73 percent. Voltage pulses of approximately 20 kV at the capacitor plates were produced by means of an electromagnetic chopper in the circuit of the induction coil, operating at a frequency of 60 Hz an amplitude of 11.2 V. Voltage pulses were displayed on an oscilloscope. Field patterns were transferred by the contactless method from the glass plate with carbon powder, first onto photographic plates and then onto photographic paper. Figures 2; tables 1; references: 2 Russian.
[99-2415]

UDC 621.373.53

A CONTROLLED GAS-FILLED MEGAVOLT DISCHARGER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 127-128 manuscript received 3 Apr 79

YEVDOKIMOVICH, V.M., YEVLAMPIYEV, S.B., KORSHUNOV, G.S., NIKOLAYEV, V.A., SVIRIDOV, Yu.F. and KHMYROV, V.V., Scientific Research Institute of High Voltages attached to Tomsk Polytechnic Institute

[Abstract] A gas-filled megavolt discharger is described which consists of 10 compartments separated by aluminum gradient rings, each connected to the corresponding brass disk of a voltage divider. The latter is a tube made of acrylic glass and the nine brass rings inside it are separated from one another by a solution of 10 percent ethanol and 75 percent glycerin in water. The two electrodes are inserted axially through the rings and form the discharge gap at the center of the chamber. A thyratron built into a dielectric sleeve is mounted at the tip of one electrode, the one at ground potential. Voltage to the discharge chamber is applied through that divider, which also established the necessary voltage profile, breakdown occurring at 280 kV between two neighboring brass disks. Splitting the single 55 mm-wide interelectrode gap into two 40 mm-wide ones by insertion of disk into the center ring of the discharger chamber, and adding 10 percent "elegas" to the air, has raised the operating voltage from 0.4 to 1.35 MV, with a 10 μs delay after the trigger pulse, without cutoff under a pressure of 1.5 MPa. Figures 3; references 3: 2 Russian, 1 Western.

[97-2415]

UDC 538.56

CALCULATION OF THE ELECTROMAGNETIC FIELD IN THIN FILMS BY THE METHOD OF NATURAL FIELD COORDINATES

Minsk IZV. VUZ: ENERGETIKA in Russian No 10, Oct 80 pp 36-42 manuscript received 7 May 80

GRACH, I.M., candidate of technical sciences, docent, Frunze Polytechnical Institute, presented by Department of Theoretical and General Electrical Engineering

[Abstract] The calculation of electric and magnetic fields as well as of the current distribution in thin-film conductors with a distinct surface effect is greatly simplified by the use of natural (curvilinear) orthogonal coordinates in which the field intensity vectors and thus also the Poynting vector each have only one component. Here the problem of establishing these coordinates is considered first, namely a general system of coordinates is reduced to one which has the required properties. In these coordinates the field parameters are then calculated assuming a harmonic Fourier equivalent of an arbitrary alternating electromagnetic field in a homogeneous thin film and then in a thin film of arbitrary configuration. As a practical example, used to illustrate the application of this method, the impedance between centers of adjacent trapezoidal grooves in a long axisymmetric thin-film conductor is calculated with the surface profile represented as a Fourier series. This problem relates to case hardening of gear teeth by the induction heating process. Figures 1; references; 6 Russian, 2 Western (in translation)
[101-2415]

ELECTRON TUBES: ELECTROVACUUM TECHNOLOGY

UDC 621.072

A METHOD OF STABILIZING THE FREQUENCY OF MICROWAVE KLYSTRON OSCILLATORS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 124-126 manuscript received 29 Jun 78

PANOV, V.I., Moscow State University

[Abstract] A method is described for stabilizing the frequency of a microwave klystron oscillator which uses a superconductor resonator for locking the frequency. Such a resonator, in the form of a 1.15 m thick niobium film deposited by electron-plasma evaporation on a specially machined single sapphire crystal (loss tangent not exceeding 2.10^{-9} at T = 2K and $f \sim 3$GHz) is placed between two supercritical waveguide couplers with adjustable coupling, one of which contains a capacitive probe and is connected to the klystron oscillator through a slidable coaxial line. With this device, a G4-9 klystron supplied from a storage battery was locked at a frequency of 2.88 GHz. The relative frequency instability did not exceed $5.1 \cdot 10^{-12}$ within 10-30 s of measuring time and the relative frequency drift was approximately $7 \cdot 10^{-11}$ during 30 min of operating time. The author thanks V.B. BRAGINSKIY and I.I. MINAKOVA for the helpful discussions, as well as P.I. ZUBTSOV and V.N. YAKIMOV for assistance in the work. Figures 3; references 11: 8 Russian, 3 Western.
[97-2415]

UDC 621.3.032.269.1+621.374

A HIGH-CURRENT-PULSE ELECTRON GUN WITH A CATHODE MADE OF LANTHANUM HEXABORIDE

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 p 242 manuscript received 4 Jan 77, first version 4 Oct 79

FEDOROV, A.L. and MEN'KOV, D.A.

[Abstract] A new electron gun was developed for producing nanosecond electron beams with currents of 1-10 kA with a duty factor ranging from 10^{-6} to 10^{-4}. Its interchangeable 2-disk cathodes 17-50 mm in diameter are made of lanthanum hexaboride and operate with forced oil cooling. The electron-optical system was designed by analog simulation on a trajectograph, to withstand an electric field intensity of 160-200 V/cm during pulses of 0.5μs duration and under a pressure of 10^{-6} torr. Both the cathode and the anode are shaped and oriented accordingly. Information concerning the electron gun may be obtained from the address: 109240, Moscow, Zh-240, Ul.Chkalova 50, State Scientific-Research and Planning Institute of the Nitrogen Industry and Products of Organic Synthesis (GIAP). Figures 2.
[97-2415]

INSTRUMENTS, MEASURING DEVICES AND TESTERS, METHOD OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES

UDC 53.084.3:621.317.3+536.2.022

AN APPARATUS FOR MEASURING THE ELECTRICAL CONDUCTIVITY AND THE THERMAL CONDUCTIVITY AS WELL AS THE THERMAL EMF OF SEMICONDUCTORS AT HIGH TEMPERATURES

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 p 261 manuscript received 8 May 79

ZHUKOV, V.F., INGLIZYAN, P.N., NAMORADZE, V.A. and SHEVCHENKO, Ya.M

[Abstract] An apparatus was developed for measuring the thermal emf, the electrical conductivity and the thermal conductivity of semiconductor materials at temperatures from room temperature to 1300°C. A specimen 10x10 mm^2 in cross section and 20-25 mm thick is placed on a molybdenum flange. A steady thermal flux is produced by a surrounding gradiental furnace, an array of shields preventing leakage of heat. The mean temperature of measurement is attained by means of a flange heater. All components in the high-temperature zone are made of molybdenum, Alundum, or beryllium oxide. The heating and measuring system is placed inside a double-wall chamber which, after evacuation, has been filled with an inert gas. Cooling water flows between the walls. All measurements are accurate within 3-4 percent. Information concerning this apparatus may be obtained from the address: 38914, Sukhumi, Sukhumi Physicotechnical Institute. Figures 1.
[97-2415]

UDC 531.787:621.51

DIGITAL DEVICE FOR MEASURING PRESSURE

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 252-253 manuscript received 21 Aug 78

D'YAKOV, Ye.P., KALACHEV, A.I., NIKULENKO, V.N., PARFINENKO, A.K. and ROZHKOV, N.F.

[Abstract] A digital device was developed for pressure measurement and control with potentiometric transducers on 15 m long cables. The instrument has a parallel-series structure with two input channels, one for the 0-0.6 MPa range and one for the 0-25 MPa range, a common measuring channel and an alarm device. The measuring channel includes a voltage-to-frequency converter with a sensitivity of 0.2 Hz/kPa. Measurements are performed by cyclic scanning of both input channels. The measuring time can be regulated from 1 to 10 s, with the referred basic error in each channel decreasing from 0.2 to 0.02 percent, correspondingly. The instrument can

be used with transducers of any other output quantity proportional to voltage. Information concerning this digital device for measuring pressure may be obtained from the address: 644050, Omsk-50, Prospect Mir 11, Omsk Polytechnical Institute, Department (Kafedra) of Information-Measuring Technics. Figures 1; references: 1 Russian.
[97-2415]

UDC 535.8

ON THE USE OF POLARIZATION SENSITIVE PHOTODETECTORS IN MEASUREMENT INSTRUMENTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 23, No 8, Aug 80 pp 84-87 manuscript received 11 Nov 79

KOROTAYEV, V.V. and PANKOV, E.D., Leningrad Institute of Precision Mechanics and Optics, recommended by the Department of Opto-electronic Instruments

[Abstract] The possibility of the use of polarization sensitive photodetectors in optronic instruments is analyzed using as an example a device for registering the angle of rotation of the plane of polarization of a light source. The experimental set-up contains a light source, lenses, collimator, polarizer, reference polarization sensitive photodetector and a motor to rotate the detector being tested. In the cases where photodiodes are employed as the detectors, equations are derived for the mean square error in the measurement of the angle of rotation; a simpler expression is also written for the case where the principal noise component is the photocurrent shot noise. An estimation of the quality of polarization sensitivity should be based on the absolute values of the detector sensitivity to light, polarized parallel and perpendicular to the tetragonal axis of the photosensitive crystal, rather than being based on the relative characteristics (e.g., pleochroism). Because the expressions show that the mean square measurement error of the rotational angle is also governed by the same formula in the case of sine wave modulation of the light flux, the possibilities for the use of polarization sensitive devices to measure twisting with phase and phase-amplitude modulation are the same. Figures 1; references: 5 Russian, 1 Western in translation.
[25-8225]

UDC 536.3

CALCULATING THE TEMPERATURE OF SEMI-TRANSPARENT OBJECTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 23, No 8, Aug 80 pp 91-95 manuscript received 11 Nov 79

YARYSHEV, N.A. and ZAROVNAYA, N.N., Leningrad Institute of Precision Mechanics and Optics, recommended by the Department of Physics

[Abstract] The temperature field of a semi-bounded solid is caused by the action of the temperature of the ambient medium, the radiative flux which is completely

normally incident to the surface of the semi-transparent solid as well as the initial temperature distribution in the solid body. During an analysis of the transient heat exchange of this semi-transparent object, in order to circumvent difficulties related to the specific features of heat exchange with such objects and to derive equations convenient for engineering calculations, it is assumed that: 1) The thermal and temperature conductivities, the specific heat, the density, the coefficient of absorption and the reflectivity of the body are constant; 2) The nonsteady state thermal conductivity process occurs under conditions of thermodynamic equilibrium of the radiation; and 3) The natural radiation inside the body is small as compared to the incident radiation from without and the radiative flux density in the body, neglecting scattering, is governed only by the absorption of the external radiation. Partial differential equations are written and solved for the surface temperature and the amplitude and phase-frequency characteristics of the surface temperature. The expressions which show the change in the surface temperature of a semi-transparent and opaque body as a function of the Fourier number are graphically illustrated. The equations may be considered as basic for the study of the dynamic characteristics of semi-transparent objects and can be applied to the synthesis of control systems. Figures 2; references: 2 Russian, 2 Western in translation.
[25-8225]

UDC 536.581+535.853.6

IPOKS-1 INSTRUMENT FOR LOW-TEMPERATURE INFRARED SPECTROMETRY OF SMALL OBJECTS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 p 254 manuscript received 26 Feb 79

MEDVEDEV, V.S., ZHIZHIN, G.N., YERMAKOV, V.M., SERGIYENKO, V.V., VINOGRADOV, Ye.A., PODOLICH, V.B. and BAGDANSKIS, N.I.

[Abstract] A device was developed for use in low-temperature (1.6-300 K) absorption and reflection measurements with infrared spectrometers, including both Soviet and foreign-made Fourier spectrometers. It is designed for spectrometry of 3x3 mm^2 large objects with series IKS instruments and of 5x6 mm^2 large objects with series FIS instruments. It consists of a circulatory helium cryostat with temperature regulation in 0.1 K steps and built-in mirror optics with a small focal length. The cryostat comes in two versions: one for measurements in the near infrared ($\lambda = 0.8$-25μm) and one for measurements in the far infrared ($\lambda = 25$-1000μm). It requires 5 liters of liquid helium for 10 h of continuous operation, during which it loses only 1.7 liters. The temperature of a specimen is maintained constant within $\pm$0.05 K at any level within the 4.2-300 K range. Information concerning this instrument may be obtained from the address: 252650, Kiev-28, GSP, Prospect Nauka 144, Institute of Physics of the UkSSR; 142092, Troitsk, Podol'sk Rayon, Moscow Oblast,Institute of Spectroscopy, USSR Academy of Sciences. Figures 1.
[97-2415]

UDC 539.2:621.38

A WIDEBAND FOURIER SPECTROMETER FOR ANALYSIS OF NUCLEAR MAGNETIC RESONANCE IN CRYSTALS CONTAINING RARE ISOTOPES

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 145-148
manuscript received 12 Dec 78

LUNDIN, A.G., PROZOROV, S.P. and SUKHOVSKIY, A.A., Institute of Physics, Siberian Department, USSR Academy of Sciences, Krasnoyarsk

[Abstract] A wideband pulse spectrometer for analysis of nuclear magnetic resonance in crystals containing rare isotopes(^{13}C, ^{15}N, ^{29}Si, ^{77}Se, ^{111}Cd, ^{113}Cd, ^{207}Pb and others) is described which operates by the method of double resonance with cross-polarization of rare nuclei and common nuclei or protons (F-19) in a rotating system of coordinates. The instrument consists of a transmitter in the interpolar space of a magnet, two channels feeding the readout equipment, and the latter consisting of a programmer, an oscillograph, a storage, an analog Fourier converter, and a recording device. The radio-frequency channel, 60 Mhz corresponding to resonance of an F-19 proton in a magnetic field of 14.09 kOe intensity, consists of a receiver with a matching circuit and includes a phase detector. The reference signal is split here into two voltages at the same 60 MHz frequency but in phase quadrature. The wideband channel, 3-15 Mhz covering the Larmor frequencies of most rare nuclei in a magnetic field of 14.09 kOe intensity, also has a matching circuit and consists essentially of a pulse modulator and a wide-band power amplifier. Here the reference-frequency signal is generated by a synthesizer. A typical spectrum obtained with this instrument is shown, namely that of ^{77}Se in a single crystal of H_2SeO_3. Figures 3; references 4: 2 Russian, 2 Western.
[97-2415]

UDC 543-45

AUTOMATIC MEASUREMENT OF THE REFRACTIVE INDEX ON THE BASIS OF THE CRITICAL ANGLE

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 10, Oct 80 pp 15-17

KARABEGOV, M.A., candidate of technical sciences, KOMRAKOV, Yu.I., candidate of technical sciences, and MCHEDLISHVILI, K.A., engineer

[Abstract] A high-precision laboratory refractometer with measurement of the critical angle and also with objective readings in units of concentration is proposed for testing of milk and other food products which contain emulsions or pigments. It consists of a prism and a telescopic objective, as well as a compensator. The principle is based on application of the shadow method or, preferably, the Fresnel method. The latter allows for measurements with slight 20-23' deviations from the critical angle without an appreciable effect of total reflection. The calibration curves follow the sensitivity of the exit light intensity and of the critical angle to changes in the refractive index, on the basis of Snell's law. Advantages of the Fresnel method are a linear relation between change in the refractive index

and change in concentration, insensitivity of the instrument scale on fluctuations of the refractive index of the prism material, and applicability to media with total reflection. Typically a 0.0005° change in the critical angle corresponds to a 3 percent change in the exit light intensity. This sensitivity can be doubled by arranging for a twofold reflection of the light beam. Figures 7; references: 4 Russian.
[96-2415]

UDC 543.46:531.715.1

MEASUREMENT OF THE DIELECTRIC CONSTANT IN A WAVEGUIDE-TYPE INTERFEROMETER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 219-221 manuscript received 29 Nov 78

MAMEDOV, D.G.

[Abstract] A modified twin-T bridge waveguide-type interferometer is described in which parasitic multiple reflections are minimized and a method is set forth for measuring the dielectric constant of materials in the microwave range. The instrument measures the shift of the intensity peak after insertion of a specimen as well as the ratio of intensity peaks with and without a specimen, respectively. From these measurements are calculated the phase constant and the attenuation coefficient, respectively the imaginary part and the real part of the propagation constant. These two quantities, together with the transverse wave number of the waveguide mode and the wave number in free space, determine the real part and the imaginary part of the dielectric constant. A correction is included in order to account for interference within the specimen. In addition to a microwave oscillator and a twin-T bridge, the instrument also includes a matching load, three attenuators, two ferrite diodes, a phase shifter, two directional couplers, a short-circuiting bar, and two short-circuiting plungers. Readings are taken with a detector and a power indicator. The shift of the intensity peak increases nonlinearly with increasing thickness of the dielectric layer, liquid or solid, so that the accuracy of its measurement is better with thick specimens. Figures 2; references 8: 5 Russian, 3 Western (in translation)
[97-2415]

UDC 550.834:53.083.8

PROBLEMS IN CURRENT PRODUCTION OF SEISMIC PROSPECTING EQUIPMENT

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 80 pp 18-20

GORELIKOV, N.I., candidate of technical sciences, and MAKSIMOV, N.V., engineer

[Abstract] Prospecting for deposits of crude oil and natural gas is in the first stage done basically by seismic methods. This activity now comprises 80-85 percent of all geophysical research done by the petrochemical industry, and its cost amounts

to 90-95 percent of the entire budget. The higher sensitivity of modern digital seismic prospecting kits such as the SSTs-4, the latest version developed at the All-Union Scientific Research Institute of Geophysics, has made it feasible to replace powerful explosive charges with much weaker nonexplosive generators of seismic waves. On the basis of favorable experience, kits "Progress-1,2,3" have been developed at the USSR Special Design Office for Geophysical Instruments, for operation with explosive charges ("Progress 1") and with nonexplosive sources ("Progress-2,3"). The basic kit consists of a receiver with a magnetic-drum recorder of analog signals, a channel commutator (48 channels with a preamplifier each), an analog-to-code converter, a format setter, a storage of weak signals, a correlator, a magnetic digital recorder, a signal reproducer, a control module, a synchronization module, and a general amplifier with a floating decimal point. The operating frequency range is 3-125 Hz, the input noise level is 0.2μV, the nonlinear signal distortion is within 0.1 percent, and crosstalk between channels has been reduced to -74 dB. Magnetic recording takes place on a 12.7 mm wide 9-track tape. The kit can operate at temperatures from 10-35°C with air conditioning. The design of all components is complete. Problems remain in further standardization and modularization, organization of manufacturing, testing, and certification processes, automation and computerization of operation as a part of mobile prospecting complex. The next generation should be most efficient and reliable, especially with built-in microprocessors and microcomputers. Figures 4; tables 1; references: 2 Russian.
[102-2415]

UDC 621.52:531.788.7.(088.8)

AN INVESTIGATION OF THE CHARACTERISTICS OF A MANOMETER WITH A BUILT-IN CHANNEL ELECTRON MULTIPLIER

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 23, No 8, Aug 80 pp 13-16 manuscript received 28 Jun 79

VYDRIK, A.A., Leningrad Polytechnical Institute imeni M.I. Kalinin, recommended by the Department of Engineering Cybernetics

[Abstract] Any manometer designed around a channel electron multiplier includes an ionizer, the multiplier and the ionization volume. Increasing the sensitivity of such manometers and extending their working range necessitate a study of the scale characteristics and absolute signal level as a function of the mutual position of the ionizer and the multiplier, and the dimensions of the ionization chamber. This paper presents the results of such a study of the sensitivity and output signal of a manometer using a VEU-6 channel electron multiplier. The alpha radiation source was ^{238}Pu with particle energies of $E_1 = 5.5$ MeV (72 percent) and E_2 5.46 MeV (28 percent); the activity level was $1.86 \cdot 10^6$ events/sec and the emission line width at the half energy level was about 0.25 MeV. The pulses were counted with a preamplifier driving a PP-15A counter and the data were fed out to a PAP-3 automatic printer and EUM-23 numerical printer. The experimental configuration is shown, along with graphs illustrating the count rate as a function of the pressure for various positions of the ionization source. A maximum sensitivity of $1.5 \cdot 10^5$ pulses/Pa·sec, a maximum output signal of 930 pulses/sec and a lower measurement

limit of $6.0 \cdot 10^{-8}$ Pa were obtained. The experimental results were used to design a model manometer, which exhibited a linear relationship between the signal level and gas pressure in a range of $1.3 \cdot 10^{-6}$ to 10^{-1} Pa and a sensitivity of 10^7 pulses/Pa·sec. The instrument can be used for gas analyzers, mass spectrometers and densitometers. The author thanks V.N. Barkovskiy for formulation of the problem and V.G. Mikutskiy for assistance during carrying out of the experiments. Figures 3; references 5: 1 Russian; 4 Western.
[25-8225]

UDC 621.317

A PHASE CALIBRATOR CONTROLLED BY A CODE SIGNAL

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 243-244 manuscript received 18 Jun 79

SAPEL'NIKOV, V.M., MUFTAKHOV, A.M., KOPANEV, A.G., DANILOV, V.M., and MAKSUTOV, A.D.

[Abstract] A discrete phase calibrator has been developed for forming two sinusoidal voltages of equal amplitudes with an adjustable phase shift between them. The calibrator is built with series K140 and K155 integrated analog microcircuits. It mainly serves as a primary or secondary reference standard for checking phase meters and phase setters. The operating frequencies are 0.05; 0.5; 1; 5; 10; 20; 50; 100 kHz. The range of phase shift angles is 0÷359.9°, and the amplitude of its output voltages ranges from 0.1 to 5 V. Regulation of the phase shift is discrete in 0.1; 1; 10; 100° steps. The basic error is 0.1° up to 20 kHz and 0.3° above 20 kHz. Information concerning this phase calibrator may be obtained from the address: 450074, Ufa-74, Frunze 32, Bashkir State University, Physics Faculty. Figures 1.
[97-2415]

UDC 621.317.39:019.3

INCREASING THE METROLOGICAL SERVICE LIFE OF THE ANALOG COMPONENTS OF INFORMATION AND INSTRUMENTATION SYSTEMS THROUGH THE CORRECTION OF THEIR INITIAL LEVEL OF PRECISION

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 23, No 8, Aug 80 pp 3-7 manuscript received 9 Oct 79

MOSTOVOY, I.V. and CHERNYSHOVA, T.I., Leningrad Electrical Engineering Institute imeni V.I. Ul'yanov (Lenin), recommended by the Department of Information and Instrumentation Engineering

[Abstract] By utilizing a function which characterizes the change in the scatter of the measurements made by a metrological system, it is possible to extrapolate from this function in order in the future to estimate instrumentation system performance. The major factors governing the metrological service life of the analog units of data and measurement systems are: 1) The quality of the circuit design;

2) The permissible level of precision of the analog components, specified in terms of the tolerances in the performance; and 3) The initial level of precision of the analog unit, specified by the values of the metrological characteristics of the unit at the outset of operation. The latter quantity is corrected during the design stage in order to optimize the function governing the metrological service life. The proposed optimization technique is illustrated by the example of a single polarity signal comparator with variable feedback. The specific circuit parameters are given and the derived expressions show that it is theoretically possible to increase the service life from 65,328 hours to 92,602 hours using the initial precision improvement technique. The relevant curves for the function characterizing the service life are also plotted and compared. Figures 3; references: 2 Russian.
[25-8225]

UDC 621.317.39:531.77

A DEVICE FOR CHECKING THE ROTATION OF A SELSYN

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 80 p 33

KRUGLOV, A.S., candidate of technical sciences, NESTERENKO, V.S., engineer, and FAZKULLIN, V.A., engineer

[Abstract] A selsyn pair is used as a remote-control electromechanical drive for inspection of components and materials inside a nuclear reactor. There is a possibility that overloading of the servomechanism will cause the receiver to pull out of step with the transmitter. A rather reliable device has been developed which indicates the angular position of the receiver shaft and thus its direction of rotation. It contains two groups of contacts and cams connected to the receiver shaft as well as a binary logic system consisting of 3 signal inverters and 3 adders at the input, 2 more adders, 8 triggers, and 2 gates at the output. This device checks the rotation of the selsyn receiver and also eliminates errors caused by vibration of the receiver rotor. Use of the device makes it possible to substantially increase the reliability of registration of the deformation of a specimen at the time of mechanical tests directly in the active zone of the nuclear reactor. It is recommended that the device be used for checking in "soft" drives. Figures 1; references: 1 Russian.
[102-2415]

UDC 621.317.49:543.422

STATISTICAL ERRORS OF PHOTOMETRIC ABSORPTION-TYPE CHEMICAL ANALYZERS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 80 pp 20-22

SHEVCHUK, A.I., candidate of technical sciences, and KORABLEV, I.V., candidate of physico-mathematical sciences

[Abstract] Absorption methods of chemical analysis in the ultraviolet and visible, and particularly in the infrared region of the spectrum, are characterized by high

sensitivity. Most photometers for this application have a 2-channel 2-beam structure. In some cases it is a differential unbalance structure and in other cases a balance structure for automatic operation with optical compensation in the main channel or in the reference channel. There are also 2-channel 1-beam logometric structures and 2-channel 2-beam structures with combination of measurement schemes. The statistical errors are analyzed in the front paper, assuming that the instrument scale has been made linear by design and taking into account a variation, not only of the information carrying parameter, namely the concentration of a substance, but also of the influencing factors such as the ambient temperature and the supply voltage. On the basis of mathematical models corresponding to the various instrument structures, expressions have been derived for the random error and the systematic error in each case. The random error, referred to the $x_{max} - x_{min}$ range of measurement, consists of an additive component the same for all structures and a multiplicative component. The former decreases with a decreasing mean-square deviation of signals and with an increasing cross-correlation factor, which is determined by the electrical noise alone when that factor approaches unity. The multiplicative component and the systematic error are largest with differential unbalance structures. The multiplicative component is smallest with balance structures operating automatically with optical compensation in the main channel. The systematic error is smallest with a combination of measuring schemes. Figures 2; tables 1; references: 4 Russian.
[102-2415]

UDC 621.317.39:536.53

DIGITAL THERMOMETER SHCH450

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 p 251 manuscript received 17 Apr 79

SHAKHKAMYAN, S.S.

[Abstract] The Shch450 thermometer measures temperatures from -200 to +650°C precisely down to tenths of a degree. A platinum-resistance probe serves as the temperature transducer. Analog-to-digital conversion is performed through time-to-pulse conversion, with simultaneous digital linearization of the calibration curve of the probe. The instrument is built with integrated microcircuits. Glow lamps serves as indicating devices for a 4-digit readout. It can operate for 500 h without recalibration at ambient temperatures from 5 to 50°C and a relative air humidity of 80 percent (35°C), and for at least 2000 h without failure. Information concerning this digital thermometer may be obtained from the address: 375014, Yerevan, Ulitsa Nersesyana 10^a, State Union Design Bureau of Secondary Instruments and Automation Elements. Figures 1.
[97-2415]

UDC 621.317.373

A WIDEBAND PHASE CALIBRATOR

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 p 250 manuscript received 19 Feb 79

GLINCHENKO, A.S., KOKORIN, V.I., CHEPURNYKH, S.V. and CHMYKH, M.K.

[Abstract] The KF-3 calibrator of phase shifts is intended for use in tuning, adjusting and automatic inspection of electronic phase meters or other phase sensing devices. It is essentially a 2-phase oscillator built on trigger-type frequency dividers with phase multistability. Digital output signals from the latter are converted to analog ones and then by lowpass filters to harmonic ones. The instrument can operate with single or cyclic changes of phase shift. Its operating frequency can be changed from 25 Hz to 10 MHz in 10 steps. Phase shift settings cover the 0-360° range in 10° steps at the 25 Hz ÷ 2MHz frequencies, in 15° steps at the 5 MHz frequency, and in 30° steps at the 10 MHz frequency, the error ranging from ±0.02° to ±0.1°, correspondingly. The output voltage across a 50 ohm load can vary from 100 to 1 mV, with a 2 percent maximum nonlinear signal distortion. Information concerning this wideband phase calibrator may be obtained from the address: Krasnoyarsk-74, Ulitsa Kirenskiy 26, Krasnoyarsk Polytechnical Institute, Department (Kafedra) of Radio Engineering. Figures 1.
[97-2415]

UDC 621.317.713

AN INTEGRATING ELECTROMETER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 105-107 manuscript received 2 Apr 79

GOL'DIN, A.A., GUZIKOV, Ye.S. and ISAKOV, Yu.A., Institute of Analytical Instrument Making, Scientific-Technical Division, USSR Academy of Sciences, Leningrad

[Abstract] An integrating electrometer is described where the 1pF measuring capacitor discharges through the control grid of the electrometric tube of the integrating amplifier in the input stage. This tube, together with an incandescent lamp, is placed inside a light-tight shield. The instrument includes a digital voltmeter at the output. The programmed control system at the amplifier output consists of a control circuit, a timer, an electronic switch, and a voltage-to-frequency converter. With an integrating time of 8 s, the instrument has a threshold sensitivity of $3 \cdot 10^{-17}$ A (rms noise component of the stray current) and measures currents of 10^{-13}-10^{-10} A with a relative error not exceeding 0.05 percent. With the integrating time varied within the 1-64 s range, the dynamic range of current measurement is 10^6. The time drift does not exceed $6 \cdot 10^{-17}$ A/h, the temperature drift is $5 \cdot 10^{-18}$ A/K, the instability of the integrating time does not exceed 10^{-6}, and the maximum output voltage is 200 V. Figures 1; references 5: 4 Russian, 1 Western in translation.
[97-2415]

UDC 621.317.757

PLOTTING THE INSTANTANEOUS COMPLEX SPECTRUM IN REAL TIME

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 83-86 manuscript received 27 Feb 79

SAMOYLOV, A.I. and CHECHULINA, A.A., Ural Electromechanical Institute of Railroad Transportation Engineers, Sverdlovsk

[Abstract] Spectrum analyzers of the resonance type include magnetic prerecording and signal time-compression. Spectrum analyzers of the recirculation type operate according to the dispersion method. An analyzer has now been developed for plotting the combined amplitude and phase spectrum in real time, which is achieved by means of a memory. Here the principle of its operation by the method of harmonic weighing is described. It is assumed that the delay line has an infinite number of taps and that the signal travels through this line. The resulting phase lead can be removed by means of a synchronizing system, but only if the starting time of the signal is known. For this purpose the discrete points at which the instantaneous spectrum is sought are selected on the frequency axis. The algorithm has been simulated on a computer for two typical signals with 2FT = 50 degrees of freedom. Here it is demonstrated, furthermore, that only one skip from $-\pi$ to $+\pi$ can occur whatever the law of variation of the initial phase during one period of a given frequency component of any real signal may be. Figures 3; references: 4 Russian.
[97-2415]

UDC 621.317.757

THE 'DEL'FIN' INFORMATION-MEASUREMENT SYSTEM

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 p 246 manuscript received 5 Sep 78

ORNATSKIY, P.P., GUSEV, I.I., KOCHANOV, E.S., YAREMCHUK. A.A., TARABAN. N. Ye. and GOROVOY, Yu.A.

[Abstract] The "Del'fin" information-measurement system was designed to analyze and process nonstationary random signals. Measurements are made in real time simultaneously over 10 channels. The system consists of a multi-channel analog-to-code converter, a storage, a special-purpose digital computer, a data display and a generator of test signals. The system can measure the mean value of 0.1-10 V random signals in the 0÷5 kHz frequency range as well as their second and fourth moments, also their envelopes. It can perform the four basic arithmetic operations. Regulation is discrete, the realization time can be 0.5-4096 s long. The memory for each channel has a capacity of 400 7-digit words. Information concerning the Del'fin system may be obtained from the address: 252056, Kiev-56, Brest-Litovskiy Prospect 39, Kiev Polytechnical Institute, Department (Kafedra) of Information-Measurement Techniques. Figures 1.
[97-2415]

UDC 621.376.32.029.7

AN ANALYSIS OF AN OPTICAL BAND FREQUENCY MODULATED EMISSION BY MEANS OF A FOUR-MIRROR INTERFEROMETER

Moscow RADIOTEKHNIKA in Russian Vol 35, No 8, Aug 80 pp 76-78 manuscript received 25 Jun 79

GUSEV, V.G., POPOV, L.N. and LEN'KOV, S.I.

[Abstract] Multiple-mirror interferometers are used to convert FM optical band emissions to AM emissions, where the reflectivity of the input mirror is significantly less than unity. There are low useful signal power losses in such discriminators for FM to AM optical band conversion. This paper analyzes a four-mirror discriminator and checks the derived expressions with the following set-up: an LG-56 optical laser was modulated with a 100 MHz signal, using a modulator based on a lithium niobate crystal. The modulating voltage was derived from a GSS-7 generator and amplified with a U-3-5 amplifier. The maximum modulation signal level at the crystal was about 25 volts, providing a modulation index of 0.5. A collimator expanded the light beam of the laser to an aperture on the order of 10 mm. The four-mirror interferometer was formed from an input light splitting cube, a total internal reflecting prism of which was secured to a piezoceramic chip for tuning in a range of one-half wavelength, and then a cube with nearly unity reflectivity. The output signal was observed on a spectrum analyzer and the signal-to-noise ratio was measured. The output of an LG-36 laser was fed to a photomultiplier to measure the signal-to-noise ratio for the beat-frequency adjacent axial modes separated by 96 MHz from each other. This signal-to-noise ratio was taken as 100 percent modulation. When the light which had passed through the discriminator was fed to the photomultiplier, the spectrum analyzer was again used in order to determine the signal-to-noise ratio, which relative to the signal-to-noise ratio for the beat frequency provided the value of the amplitude modulation level at the interferometer output when the FM emission was fed to its input. The graphical illustration of the results shows good agreement with the theory. The optimum reflection coefficient is 0.2 for minimum conversion losses. Figures 3; references 3: 2 Russian, 1 Western (in translation)
[29-8225]

UDC 681.327.17

SIMPLE TESTING CIRCUITS FOR INTEGRATED TRANSISTOR-TRANSISTOR-LOGIC SYSTEMS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 160-163 manuscript received 30 Jun 77

SKOLETSKIY, I.P., Azerbaijan Institute of Petroleum and Chemistry, Baku

[Abstract] Five testing circuits for integrated transistor-transistor-logic systems are described which feature relative simplicity for use in debugging and repair. They are also based on integrated microcircuit chips, with light emitting diodes as indicating devices. Two of them are pulse-potential logic testers and

three of them are potential logic testers. Digital indication as well as 1- or 2-color indication of up to 8 different states of the inspection point are available. All operate from a 5 V supply and require no adjustments. Reliability and long life are ensured by absence of any switching contacts. Figures 7; references: 4 Russian.
[97-2415]

UDC 621.382.2.029.64

A METHOD OF MEASURING THE RATIO OF PEAK CURRENT TO MINIMUM CURRENT OF GUNN-EFFECT DIODES

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 103-105
manuscript received 23 May 79

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[Abstract] The ratio I_{max}/I_{min} on the dynamic current-voltage characteristics is an essential parameter of a Gunn-effect diode, which indicates what the performance of a manufactured device will be. Its measurement by means of heating the electrons in a microwave field is intricate and tedious. Here a simpler method is proposed namely measuring the peak current I_{max} at the Gunn-effect oscillation threshold and the average diode current at voltages above the threshold. The method is based on the relation between average current, minimum current, current sweep $I_{max}-I_{min}$, and the relation between domain formation and annihilation time and ion transit time. The test equipment includes a coaxial line segment with a low characteristic impedance, a still lower load impedance, and a large capacitance, connected together with the diode test specimen into an emitter-follower transistor circuit. Measurements are made at a frequency much below resonance. The method has been tried with Gunn-effect diodes built on sufficiently homogeneous and long (more than $10\ \mu$m) n-GaAs single crystals, and found to be as accurate as the conventional method. Figures 1; references 7: 2 Russian, 5 Western.
[97-2415]

UDC 621.383.292

AN INSTRUMENT FOR MEASURING THE FREQUENCY CHARACTERISTICS OF VISIBLE-RADIATION PHOTODETECTORS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 194-195
manuscript received 17 Jul 79

GONCHUKOV, S.A., YEMETS, Ye.P., KASUMOVA, R.D. and PROTSENKO, Ye.D., Moscow Institute of Engineering Physics

[Abstract] An instrument for measuring the frequency characteristics of visible-radiation photodetectors is described which uses a two-modal He+Ne laser ($\lambda=0.63\ \mu$m)

with a controllable internal anisotropy. The frequency of intermodal beats can be varied smoothly over the 20-520 MHz range, the upper limit determined by the L=29 cm length of the laser resonator cavity and the lower limit determined by intermodal coupling. The latter limit can be lowered to 2 MHz by application of a 20-200 Oe strong constant magnetic field in the direction of the optical axis. Use of a gas mixture containing equal amounts of ^{20}Ne and ^{22}Ne isotopes further widens the range of frequency mismatch between modes without affecting their stability. The equipment consists of a gas-discharge tube between the poles of a magnet, a methane cell, a quartz-crystal optical wedge, all between the two resonator mirrors, as well as a sawtooth-voltage generator, a piezoceramic plate behind one resonator mirror, a polarization light filter, and behind the tested photoreceiver a spectrum analyzer. The frequency characteristics of several photoelectron multipliers were measured with this instrument. Figures 2; references: 3 Russian.
[97-2415]

UDC 621.382

PROBLEMS IN PRODUCING AN ELEMENTAL BASE OF A VERY-HIGH DEGREE OF INTEGRATION FOR A COMPUTER

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 6, Nov-Dec 80 pp 483-490 manuscript received 17 Jan 80

VALIYEV, K.A.

[Abstract] The basic trend in microelectronics development is toward very-large-scale integration and very-high-speed operation. The former requires reduction of the size of components from 10^2 to 0.1μm and an increase of the number of components per crystal from 10 to 10^6. The latter requires reduction of the switching time from 10^2 to 0.1 ns. Achievement of this goal is expected by 1985-90, not at once but in three progressive stages. Such a miniaturization of microelectronic devices will alter their transistor characteristics and mode of functioning, especially in the last submicron stage of size reduction to the range of Bohr radii, Broglie wavelengths and Debye shields. Avoiding dangerously high electric field intensities will require the use of higher-purity materials and surfaces as well as lower operating voltages in service. Both bipolar and MOS silicon devices are under consideration, each type characterized by different capabilities and different optimum performance ranges. Various technologies such as photolithography and x-ray lithography are now available for transferring the device topology from a mask onto a crystal, the trend however is toward more extensive use of electron beams and ion beams so that further developments of appropriate sources are expected here. Cold processes are preferable as a way to avoid plastic deformation and to improve the precision, especially during doping and film deposition. Typical devices to be produced are a computer with a 65 kbit memory on a single crystal and polycrystalline logic or matrix circuit, each with a power rating of 1 W per crystal. Figures 5; tables 7; references 9: 3 Russian, 6 Western.
[100-2415]

UDC 621.382

BASIC PHYSICAL CONSTRAINTS ON COMPONENTS OF INTEGRATED CIRCUITS

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 6, Nov-Dec 80 pp 491-497 manuscript received 17 Jan 80

KOKIN, A.A.

[Abstract] Without consideration of technoeconomic indicators, the capabilities of discrete diode elements in integrated-circuit logic are examined from the physicotechnical standpoint. Those capabilities are defined in terms of five parameters, each constrained by some specific factors. The minimum logic differential (ultimate theoretical 0.2 V; already attained 0.5 V) depends only on the thermal energy per electron charge and is limited by the temperature. The minimum size of the semiconductor structure (ultimate theoretical 0.1 μm; already attained 1 μm) depends on the drift time and the energy relaxation time as well as on the signal propagation time and is limited by breakdown of the p-n junction. The minimum total delay time (ultimate theoretical 1 ps; already attained 100 ps) depends on the power dissipation and is limited by the size as well as the heat. The maximum degree of integration (ultimate theoretical 10^8 cm^{-2}; already attained 10^6 cm^{-2}) is limited by the size and the state of technology. The minimum figure of merit defined as the product of energy spent in one logic operation (ultimate theoretical $P_{min} \tau_{opt} = 0.3$ fJ or $P_{opt} \tau_{min} = 2$ fJ; already attained 100 fJ: $P_{min} = 1$ μW, $P_{opt} = 1$ mW, $\tau_{opt} = 1$ ns) is also limited by the size and the heat. These data refer to silicon diodes operating at a nominal ambient temperature of 300 K. It is noteworthy that with logic and memory components built on the principle of the Josephson effect it appears feasible to attain a figure of merit of the order of 1 fJ, mainly because they would operate at low temperatures. Tables 1; references 10: 6 Russian, 4 Western (1 in translation).

[100-2415]

UDC 621.382

ELECTRON SENSITIVE AND X-RAY SENSITIVE RESISTS IN MODERN MICROELECTRONICS

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 6, Nov-Dec 80 pp 517-539 manuscript received 17 Jan 80

SELIVANOV, G.K., MOZZHUKHIN, D.D. and GRIBOV, B.G.

[Abstract] Electroresists for modern microelectronics must feature a high sensitivity (at least 10^{-5}-10^{-5} C/cm^3), a high resolution (down to 0.2-0.3 m), a low microdefectiveness (within 0.1 cm^{-2} in 0.3-0.6 m thick films), and a high degree of thermal, chemical and plasmochemical stability. No one material combines all these characteristics, each being most suitable for certain applications only so that each application requires a different choice and some tradeoff. Positive electroresist materials include polymethyl methacrylate, the sensitivity of which has been improved by the use of an appropriate developer mixture (ethyl acetate + isoamyl acetate) or an appropriate polymer base (syndiotactic and isotactic isomers),

by multilayer coating of the substrate, or by modification of the polymer chain. Although many more negative electron sensitive materials are available, their physico-chemical characteristics make them less suitable for use as electroresists. Most adaptable among them are high-molecular compounds containing unsaturated double bonds and epoxide groups. Technologically x-rays are in strong competition with electron beams, especially for submicron microelectronics, if only the complexity of mask preparation can be reduced, special methods of alignment can be developed, and the problem of long exposure time can be overcome. At present, until more sensitive x-ray resists are developed, electroresists are also used in x-ray technology. Figures 2; tables 3; references 76: 4 Russian, 72 Western.
[100-2415]

UDC 621.382.002.5

ELECTRON-BEAM LITHOGRAPHY AS AN EFFECTIVE METHOD OF PRODUCING SUBMICRON-SIZE COMPONENTS OF LARGE-SCALE INTEGRATION

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 6, Nov-Dec 80 pp 498-516 manuscript received 11 Jan 80

DERKACH, V.P. and KUKHARCHUK, M.S.

[Abstract] Electron-beam lithography offers several advantages over photolithography. The resolution is much better than can be attained optically, because of the lesser diffraction and the much shorter electron wavelength. The deeper focus relaxes the requirements with respect to planarity and positioning of the treated surface. Localization of the process is effected by control of electric and magnetic fields through a computer, rather than by mechanical movement of parts, which makes the treatment both faster and more precise. An electron beam contains, furthermore, much more energy than a light beam and this is particularly advantageous in the treatment of special electron-sensitive layers. Either photoresists or electroresists can be used with an electron beam, both positive and negative polymers and organosilicon compounds being available in the latter category. The performance of any resist depends on its characteristic energy absorption, scattering and reflection profiles as well as on the film thickness and the substrate material. In addition the present trend is toward replacement of "wet" preparation processes by "dry" ones. The subsequent scanning process is programmed on and controlled by a computer, modern equipment including an electron gun with a tungsten or lanthanum hexaboride cathode, a 2-3-lens focusing system and a deflecting system. The basic modes of tracing the layout are raster scanning and vector scanning with either continuous or stepwise travel of the stage and usually with adjustable cross sectional dimensions of the electron beam. Markers are used for checking with subsequent automatic error calculation and correction as well as control of the exposure time. Here the performance characteristics of the "Kiev-70" and the EN-30-5000 Å-I electron-beam lithography systems are compared with those of 18 foreign makes. The authors thank B.A. GRABOVSKIY, L.Ya. ZGUROVETS and V.R. RAKITSKIY for the assistance in organizing this survey. Figures 7; tables 2; references 41: 32 Russian, 9 Western.
[100-2415]

UDC 621.382.002.5

LOWERING THE TEMPERATURE OF BASIC PHYSICO-CHEMICAL PROCESSES IN MICROELECTRONIC TECHNOLOGY AS A WAY TO INCREASE THE RELIABILITY OF INTEGRATED CIRCUITS

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 6, Nov-Dec 80 pp 540-547 manuscript received 17 Jan 80

CHISTYAKOV, Yu.D.

[Abstract] In all processes, except photolithography, heat is the vehicle by which energy is supplied to the microelectronic system during processing. One way to diminish the drawback of heat and thus obtain better control of the processes, and consequently also more reliable integrated circuits, is to lower the process temperature. Other ways would be to use modes of energy transfer such as ultraviolet or infrared radiation, or to resort to controlled mass transfer in electric or magnetic fields. The possibilities and the implications of lowering the process temperature are examined here, relative to the three basic processes in microelectronic technology. In epitaxial growth by deposition from the vapor-gas mixture $SiCl_xH_{4-x} + H_2$ it appears feasible to lower the temperature from 1100-1200°C to 900 ± 50°C by shifting x $(0 - x - 4)$ to the eutectic point, without adversely affecting the continuity of a layer and its surface structure or otherwise destabilizing the process. An alternative process altogether would be molecule-beam epitaxy, also feasible at 850-900°C. The high temperature (1100-1200°C) of the thermal oxidation process can be lowered to 900 and even 800°C, if the quality of the film is not a critical factor, by either decreasing the electric charge at those lower temperatures or by increasing the pressure. An alternative process would be anodizing. The high temperature (1100-1200°C) of the silicon doping process can be lowered not by simultaneously lengthening the diffusion path, which is ineffective, but by "cold" doping at room temperature in an electrolytic tank under a high voltage (up to 10 kV) or by ion implantation with subsequent laser annealing. The author thanks V.F. DORFMAN for helpful discussion during writing of the paper. Figures 3; references 40: 20 Russian, 20 Western.
[100-2415]

UDC 621.382.8

OPTICAL METHODS OF MEASURING THE DIMENSIONS OF COMPONENTS ON A TOPOLOGICAL LAYOUT FOR LARGE-SCALE AND VERY-LARGE-SCALE INTEGRATION

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 6, Nov-Dec 80 pp 554-563 manuscript received 14 Jan 80

VOLKOV, V.V., GERASIMOV, L.L., KAPAYEV, V.V., LARIONOV, Yu.V. and RAKOV, A.V.

[Abstract] The dimension of any component of a microcircuit topology is a slowly varying function of the space coordinates. Conventional optical and electrooptical methods of measuring the linear dimensions of components, on the mask or on the wafer, employ an optical microscope, a television micrometer, or an instrument which measures the space distribution of luminous energy behind the object. For large-

scale and very-large-scale integration these methods are not sufficiently accurate and effecient. Furthermore, they require statistical data processing in order to ensure an adequate inspection reliability. The feasibility of measurement by the diffraction method is examined here. A one-dimensional uniform diffraction grating on a photomask serves as the test case. An analysis according to the scaler theory, applied to the Fraunhofer region, reveals the possibilities as well as the limitations of this method. Measurement of dimensions down to 0.4 μm with an accuracy not worse than ± 3 percent appears feasible. Figures 5; references 21: 8 Russian, 13 Western (2 in translation)
[100-2415]

UDC 621.382.82

MEASURING THE PHYSICAL PARAMETERS OF LARGE-SCALE AND VERY-LARGE-SCALE INTEGRATED MICROCIRCUITS

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 6, Nov-Dec 80 pp 548-553 manuscript received 17 Jan 80

VALIYEV, K.A. and RAKOV, A.V.

[Abstract] In effect, an integrated microcircuit is a solid body consisting of a semiconductor crystal with various impurity regions, dielectric insulation layers and thin-film metal connections. The physical parameters of such a structure into four groups which respectively characterize: 1) The geometry (chip width, misalignment, film and layer thickness); 2) The chemical composition and concentration (of semiconductor material and of impurity) distributions, as well as depth of p-n junction embedment and distance between high-impurity regions); 3) The defectiveness (density of defects, size of defects other than those in the crystal structure, angle of deviation from the crystallohraphic plane, riser of wafer deflection, deviation from planarity); and 4) The electrophysical properties (electrical surface resistance, charge density, rate of surface recombination, charge carrier mobility), also those of test circuits (current, voltage, capacitance). Each parameter is measured by the method most suitable for its range of values and which ensures the accuracy required. Tables 4; references: 5 Western in translation.
[100-2415]

OPTOELECTRONICS, QUASIOPTICAL DEVICES

UDC 621.373.826

A SWITCH FOR CONTROL OF ELECTROOPTICAL DEVICES

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 141-143
manuscript received 17 Apr 79

PYATETSKIY, R. Ye. and GURSKIY, V.B.

[Abstract] An electronic switch for control of electrooptical devices is shown to be capable of commutating voltages up to 500 kV, with pulse rise times as short as 0.2μs, at a rate of 0-500 kHz over a wide range of pulse duty factors, without excessive power drain and excessive power dissipation in transistors. It consists essentially of two pulse shapers in parallel, each followed by two pulse shapers in parallel and transistor-transformer output stages. All pulse shapers are built on triggers and logic, driven respectively by a positive and a negative leading edge of the clock pulse, the two first pulse shapers producing pulses of 0.4μs duration and the next four pulse shapers producing pulses of 0.25μs duration. The last two power transistors must be mounted on radiators for operation at frequencies above 100 kHz and must be additionally cooled for operation at frequencies above 300 kHz. Figures 2; references 2: 1 Russian, 1 Western in translation.
[97-2415]

UDC 621.376.32.029.7

TEMPERATURE STABILIZATION OF AN OPTICAL FM TO AM DISCRIMINATOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 23, No 8, Aug 80 pp 66-70 manuscript received 27 Jun 79

GUSEV, V.G. and POPOV, L.N., Siberian Engineering Physics Institute attached to Tomsk State University, recommended by the Department of Quantum Electronics

[Abstract] A modified Rozhdestvenskiy interferometer was the basis for the construction of a dual beam discriminator for the conversion of optical band frequency modulation to amplitude modulation. The discriminator consisted of two light splitting cubes 20x20x20 mm with reflection factors close to 50 percent and a total internal reflecting prism; the cubes and the prism were made of optical glass and glued to a fused quartz crystal 61 mm long. Thermistors were used in order to monitor the temperature stabilization process inside the discriminator. The system was excited by an LG-56 laser. The frequency deviation of the laser radiation was

measured; the maximum deviation of the LG-56 was 56 MHz over a period of 10 minutes. The discriminator was capable of optical band FM to AM conversion with a deviation of up to 450 MHz. The operating point floated in a range of ± 6.28 MHz. A block diagram of the set-up is shown, although no detailed drawings or analytical expressions are given. Figures 2; references 6: 5 Russian; 1 Western.
[25-8225]

OSCILLATORS, MODULATORS, GENERATORS

UDC 621.317.795

A GENERATOR OF PULSING VISIBLE AND INFRARED RADIATION

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 p 253 manuscript received 12 Oct 78

GUSHCHIN, A.Yu., KOROTKOV, A.M. and SOLDATKIN, N.P.

[Abstract] A generator of pulsing visible and infrared radiation was developed for use in tuning and calibration of optical radiation receiver or other optoelectronic devices. The radiation source is a light-emitting diode excited by an oscillator with a low output impedance. Radiation at wavelengths from 0.45 to 1.06 μm can be generated bu using the appropriate type of diode. The pulse power of visible radiation is 15 mW. A quartz oscillator ensures frequency stabilization within 10^{-5}, tuning is effected by means of a frequency divider, and focusing is done with a built-in "Yupiter-3" objective. The electrical part of the instrument is built with series 155 and 118 microcircuits and silicon transistors. The pulse duration can be varied from 25 ns to 1 μs, with a repetition rate from 10 Hz to 10 MHz. Both positive and negative synchronizing pulses are available. Information concerning this generator may be obtained from the address: 634055, Tomsk, Prospect Academician 1, Special Design Bureau for Scientific Instrument Building "Optika", Siberian Division, USSR Academy of Sciences. Figures 1.
[97-2415]

UDC 621.373.5

A HIGH-POWER THYRISTOR-MAGNETIC PULSE GENERATOR

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 117-119 manuscript received 9 Jan 79

GORDEYEV, P.G., POLYAKOV, N.P., RUMYANTSEV, P.P., SINENKO, V.V. and YARUSHKIN, Yu.P., Tomsk Polytechnic Institute

[Abstract] A magnetic generator of bipolar pulses is shown which consists of two identical stages supplied from a 12-phase rectifier through an LC filter and connected to the primary of a pulse transformer with a center tap. Each stage includes a power bank of seven thyristors in series and a protective bank of five thyristors in series, both banks equipped with equalizing resistors. Voltage pulses with an amplitude of 40 kV, a rise time of 0.4 μs, and a duration of 1 μs are formed across a 62.5 nF capacitor at a repetition rate up to 1 kHz. These pulses can each

deliver a power of 125 MW to a load, with an average power in the load equal to 50 kW. For protection in the case of short circuit on the load side, a π-network of four 62.5 nF shunt capacitors and four series saturable reactors is connected between the load and the main capacitor through a relaying system with a dynistor triggered by discharge of the main capacitor and an optron thyristor fired by this dynistor. The efficiency of this generator is 64 percent at a pulse repetition rate of 1 kHz. Figures 2; tables 1; references: 5 Russian.
[97-2415]

UDC 621.373.826.038.84

A GENERATOR OF RADIO-FREQUENCY PULSES FOR LASERS WITH TRANSVERSE HIGH-FREQUENCY DISCHARGE

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 80 pp 207-209
manuscript received 14 May 79

MIKHALEVSKIY, V.S., TOLMACHEV, G.N. and KHASILEV, V.Ya., Scientific Research Institute of Physics, Rostov-on-the Don State University

[Abstract] Radio-frequency pulses are used for excitation of the active medium in elemental-vapor lasers with a transverse high-frequency discharge. A generator of such pulses has been built on a cermet triode in the commongrid circuit configuration, with a tunable tank circuit and with voltage feedback from the anode to the cathode through a capacitive divider. The generator is modulated by means of another triode, this one operating as a switch upon application to its grid of rectangular pulses of 100 V amplitude and 1-100 μs duration, and is connected to the discharge tube with external electrodes through a tunable C-L-C π-network. The generator was used for excitation of a Cd and He vapor mixture under a pressure of 40 torr. The pulse power is proportional to the excitation frequency over the 2.5-30 MHz range and reaches 10 kW at the top frequency, producing then a laser emission pulse of 3.8 W. The power of the excitation pulse can be regulated smoothly by varying the anode voltage. The maximum average power delivered by this generator through radio-frequency pulses of 3 μs duration at a repetition rate of 10 kHz is 120 mW. Figures 3; references: 4 Russian.
[97-2415]

PRODUCTION TECHNOLOGY

UDC 621.382.002

EXPERIENCE IN ORGANIZING THE PRODUCTION OF SPECIAL-PURPOSE THIN-FILM HYBRID-INTEGRATED-CIRCUIT DEVICES FOR ANALYTICAL INSTRUMENTS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 80 pp 36-37

POLUBOYARINOV, A.G., chief, All-Union Planning Department, State All-Union Trust for Construction and Installation of Industrial Instruments [VPO "Soyuzprompribor"], VIGDOROVICH, V.N., doctor of technical sciences, ZAVODYAN, A.V., candidate of technical sciences, and GAZEYEV, N.I., candidate of technical sciences

[Abstract] Thin-film hybrid devices with medium- and large-scale circuit integration have been found to be most suitable for primary data conversion in analytical instruments and subsequent electronic data processing. Their technology involves a series of precise operations which require high-purity materials and a clean environment, as well as special manufacturing equipment and highly qualified personnel. Accordingly, problems in organizing their production include plant layout, process optimization, air conditioning, adequate power and water supply, availability of compress air, protective clothing for personnel, as well as mechanization and automation of operations. Along these lines, a segment of a production line has been installed at the "Manometr" plant in Moscow for special-purpose hybrid-circuit integration. It includes stations where, respectively, substrates are chemically treated, thin films are deposited, photolithography is done, circuits are assembled and microwelded, then hermetized, varnished, marked, and packaged, as well as intermediate testing and inspection points. Under consideration is the introduction of devices with structures of vanadium-copper-nickel and vanadium-aluminum resistance alloys, equipping the plant for second- and third-degree microcircuit integration of these structures, and training the personnel for this purpose. Personnel training is always one of the most difficult and time consuming tasks in an overall organizational scheme. It is expected that within the next few years the "Manometr" plant will begin to produce microcircuits for manometers and differential manometers as well as for secondary instruments on an increasingly large scale. References: 3 Russian.
[102-2415]

QUANTUM ELECTRONICS

UDC 535.317.1

CALCULATION OF THE IMPACT OF PRODUCTION PROCESS ERRORS ON THE QUALITY OF A HOLOGRAPHIC IMAGE

Leningrad IZVESTIYA VYSSHKIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 23, No 8, Aug 80 pp 70-74 manuscript received 29 Oct 79

NIKOLOV, I.D., Leningrad Institute of Precision Mechanics and Optics, recommended by the Department of Optical Instrument Theory

[Abstract] The fundamental differential equations for determination of the coordinates of a holographic image in a Gaussian field, taking into account the refraction index of the registering medium, are written and solved in order to find the mathematical functions governing the distortions of holographic images, which are a consequence of the technological errors of recording and reproduction. The applicability of the derived distortion formulas is illustrated with two examples: 1) The design of holographic optics with specific structural parameters. The sample calculation considers the change in the refraction index caused by photochemical processing of the exposed hologram and the shrinking of the photoemulsion. The relative errors in the wavelength, wavelength magnification and reproduction scale of the optics are computed; the relevant errors in the corresponding angles and wave front radii are also computed along with the error in the meridianal angle of the main beam of the image and the image defocusing. 2) The calculation of the displacement of a microhologram image. A holographic diffraction grating for a wavelength of 633 nm and a binary code step at the information mask of 1 mm with a focal length of the Fourier objective of 350 mm was designed in order to check the location of an image reproduced from a microhologram. The relevant computer calculations are not given, although the factors affecting the adjustment of the shaping optical systems are discussed. The simple mathematical expressions derived for the determination of image distortions caused by fabrication related imperfections of the optics can be used to find the amount of misfocusing and shift of an image, thereby allowing for adjustment of the optical instrument. Figures 1; references 4: 2 Russian; 2 Western.
[25-8225]

UDC 621.378

A PARTIALLY MISALIGNED FOUR-REFLECTOR RESONATOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 23, No 8, Aug 80 pp 74-80 manuscript received 19 Dec 78

AL'TSHULER, G.B., KARASEV, V.B. and STUDENIKIN, L.M., Leningrad Institute of Precision Mechanics and Optics, recommended by the Department of Quantum Electronics

[Abstract] With any slight misadjustments of the components of a laser resonator, its optical axis circuit (the circuit formed by a self-conjugate beam after traveling the loop of all resonator elements) is deformed, but nonetheless preserved. In this sense, these resonators can be termed 'partially misaligned'. In contrast to linear or ring resonators, formed by an odd number of reflecting surfaces, a resonator with an even number of reflectors can be designed as a 'partially misaligned' variant, without the insertion of focusing elements in it. Previous literature has shown that in the case of a one-time trip around the resonator, the field rotation angle is one of the most important parameters which govern the basic properties of such resonators with plane reflecting surfaces: the criticality to misalignment, as well as the spectrum of longitudinal and transverse modes. The field rotation angle is defined as the rotation angle of the beam cross-section of paraxial beams about the axis of the self-conjugate beam after traveling around the resonator. This paper derives expressions for the deformation of the axial circuit of a resonator caused by misadjustment of a reflector, and recommendations are made for the choice of the parameters of a simple, partially misaligned resonator containing four reflecting surfaces. The impact of the field rotation angle on the diffraction losses and the natural modal spectrum of the resonator is analyzed. The experimental checks were made with a laser having a perimeter length of 3 m using an active element of neodymium glass 12 x 270 mm; the structural configuration and design parameters of the resonator are also given. This resonator exhibits a number of advantages over plane resonators and can be used in laser circuits with strict requirements placed on stability, operational reliability and transverse distribution homogeneity of the laser intensity. Figures 5; references: 8 Russian.
[25-8225]

RADARS, RADIONAVIGATION AIDS, DIRECTION FINDING, GYROS

UDC 62-52

A STUDY OF LOCK-ON TO A MOVING OBJECT BY AN ORIENTATION AND STABILIZATION SYSTEM

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 23, No 8, Aug 80 pp 17-21 manuscript received 11 Apr 79

GRIGOR'YEV, V.V., KOROV'YAKOV, A.N. and USHAKOV, A.V., Leningrad Institute of Precision Mechanics and Optics, recommended by the Department of Automation

[Abstract] An important measure of the quality of orientation and stabilization systems which re-orient an aiming device so that the system can lock on to the moving object being observed through the stabilization of the viewing angles is specifically the lock-on capability of the system. The most general case of such systems (an intertialess nonlinear element driving an actuating unit having inertia, where a feedback circuit loops both of the elements in series) is analyzed in order to determine the range of initial mismatching for which locking on to an observed object moving in a specified trajectory is assured. The limitations on the acquisition aperture are determined and the sufficient lock-on conditions are derived in the form of a set of trajectories of the observed object which are acquired by the system from a limited initial mismatch region. Extensive use is made of matrices in the analysis and the technique is illustrated with a sample calculation for a target acquisition system with an aperture radius of $8\cdot10^{-4}$ rad, where the parameters of the system are represented by matrices and the DF and ranging characteristic is a model with a piecewise linear approximation. The target moves along a trajectory also specified in matrix form and an estimate is found for the range of values in which the system will lock on to the moving object. The results are applicable to the synthesis of spatial tracking systems, setting up the search for objects either moving or distributed in space as well as estimating the efficiency of guidance instruments. Figures 2; references: 5 Russian.
[25-8225]

UDC 621.3078

ON THE DESIGN OF A NONLINEAR FILTER FOR ESTIMATION OF THE STATUS OF A GYROSCOPIC STABILIZER

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 23, No 8, Aug 80 pp 52-56 manuscript received 5 Jul 79

LEPORSKIY, A.A., Leningrad

[Abstract] One of the drawbacks to the use of special systems such as Kalman filters in order to estimate angular coordinates and velocities (state variables) in gyroscopic units which are not amenable to direct measurement is the fact that these systems are only applicable to linear units. This paper is concerned with the construction of a stable filter which realizes an asymptotic estimate of the state of an object with a nonlinear meter. The analysis is based on the example of a power gyroscopic stabilizer with a nonlinear precession angle transducer. It is assumed that the base of the stabilizer is stationary and that the moments of the dry frictional forces and other perturbations relative to the instrument axes are zero. Differential equations are written and solved for this system, and a specific design example is given. It is found that: 1) The estimation of gyroscopic stabilizer status in a linear filter is made with a steady-state error, which is a function of the type of nonlinearity of the precession angle transducer; and 2) An asymptotic estimation is achieved in a nonlinear filter, if the linear approximation of the filter is observable, while its feedback matrix is chosen taking into account the characteristics of transducer nonlinearity. References 2: 1 Russian; 1 Western.
[25-8225]

UDC 621.317.7

ON AN ESTIMATE OF THE RESOLVING POWER OF A RING LASER AS AN ABSOLUTE ANGULAR VELOCITY SENSOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
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GOLOVAN, S.A. and SALMIN, A.V., Moscow Higher Engineering School imeni N.E. Bauman, recommended by the Department of Theoretical Principles of Electrical Engineering

[Abstract] While the resolving power of a ring laser can theoretically be increased without limit when registering the constant value of an angular velocity by means of increasing the observation time, it is nonetheless limited by low-frequency fluctuations in the output signal, in addition to the natural high frequency fluctuations of a quantum origin. The low-frequency fluctuations, which are primarily caused by instability in laser parameters, structural imperfections and a change in the parameters during operation, are taken into account in adducing an expression for the mean deviation of the output signal frequency. An analysis of this expression shows that the resolving power of ring lasers is not determined by quantum noise, but by all of the technical factors determining the low-frequency noise. The

impact of these low-frequency technical factors on the precision of absolute angular velocity measurements can be reduced by modulating the useful component of the laser signal, thus allowing its detection against the accompanying noise background. A block diagram of a proposed angular velocity meter is given and the relevant analytical expressions are derived for the mean square deviation of the output signal as a characteristic of the measurement error. It is shown that the contribution of the technological fluctuations to the measurement error falls off with an increase in the useful signal modulation frequency. In a sample calculation for a modulation frequency of 2·3.1416·20 rad/sec, a mean square error of 0.019 Hz is found. Figures 1; references: 5 Russian.
[25-8225]

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INTERMITTENT GAIN REGULATION IN THE OPTICAL RECEIVER OF A LASER-TYPE RANGE FINDER

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[Abstract] Laser-type range finders ("LADARS") used for measuring the transparency of the atmosphere require intermittent gain regulation in the optical receiver, where input signals caused by backscattering can greatly exceed the intrinsic noise level. Here a scheme is shown for widening the dynamic range of the receiver by stepwise gain regulation. The receiving photoelectron multiplier is treated as a multistage amplifier and the load resistors are connected into the supply circuit of the diode bank. As the useful signal weakens with increasing distance, successive dynodes are switched from saturation to linear mode of operation. A dynamic range of 100 dB is attainable by adjustment of the supply circuits to various dynodes. The equipment includes a chain of driven multivibrators which generate a sequence of four pulses and a shift register which generates steep scanning gate pulses. The latter, through control circuits, open the switches of appropriate dynodes. A switching time not exceeding 0.1 μs is possible. Figures 3; references: 2 Russian.
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